

Polycyclic Aromatic Hydrocarbons

General Information

Polycyclic aromatic hydrocarbons (PAHs) are a class of chemicals that result from the incomplete burning of coal, oil, gas, wood, garbage, or other organic substances, such as tobacco and charbroiled meat. Exposure to these chemicals usually occurs as exposure to mixtures and not to individual chemicals. Exposure can occur through air, water, soil, or food. PAHs enter the air from motor vehicle exhaust, residential and industrial furnaces, tobacco smoke, volcanoes, agricultural burning, residential wood burning, and wildfires. Seasonal variations in exposure to PAHs are known to occur. The soil and water near industrialized areas can contain elevated concentrations of PAHs. Foods that contain PAHs include smoked, charcoal-broiled, and roasted foods and plant foods that become contaminated by atmospheric deposition. Cereal products (e.g., wheat, corn, oats, and barley) may contain PAHs because of methods used to dry them.

Workers in certain occupational settings are exposed to PAHs from the burning or coking of petroleum products. Workplace situations include coke production, coal gasification and gas refinery, iron or steel production, roofing tar and asphalt application, chimney sweeping,

waste incineration, and aluminum smelting. Coal tar is composed of PAHs and can be used as a medical therapy for psoriasis. OSHA have developed criteria on the allowable levels of these chemicals in the workplace. The U.S. EPA and The U.S. Food and Drug Administration (U.S. FDA) have only limited or preliminary standards for a few PAHs in water or food.

PAHs can be absorbed through the skin, respiratory tract, and gastrointestinal tract (Ramesh et al., 2004). In cells, some PAHs can bind and stimulate the Ah receptor, which in turn induces a greater metabolism of the PAHs themselves to products that can interact with DNA and promote cancer (Nebert et al., 2004). Lung, genito-urinary, and skin cancers have been reported in occupational settings, where the amount of exposure is greater than it is in the general population (Lloyd, 1971; Redmond et al., 1976; Boffetta et al., 1997; Bostrom et al., 2002; Armstrong et al., 2004). Additionally, PAH exposure may affect the immune system (Li et al., 2003) and reduce fetal growth (Dejmek et al., 2000; Perera et al., 2003). Early studies have been limited by the inability to evaluate the isolated effects of individual PAHs and other contributing carcinogens, such as those in tobacco smoke. IARC classifies benz[a]anthracene and benzo[a]pyrene as probable human carcinogens, and

Table 33. Polycyclic Aromatic Hydrocarbons (PAHs) and their metabolites

PAH (CAS number)	Urinary hydroxylated metabolite (CAS number)
Benz[a]anthracene (56-55-3)	1-Hydroxybenz[a]anthracene (69847-26-3) 3-Hydroxybenz[a]anthracene (4834-35-9) and 9-Hydroxybenz[a]anthracene
Benzo[c]phenanthrene (195-19-7)	1-Hydroxybenzo[c]phenanthrene 2-Hydroxybenzo[c]phenanthrene (22717-94-8) 3-Hydroxybenzo[c]phenanthrene
Chrysene (218-01-9)	1-Hydroxychrysene(63019-38-5) 2-Hydroxychrysene (65945-06-4) 3-Hydroxychrysene (63019-39-6) 4-Hydroxychrysene (63019-40-9) 6-Hydroxychrysene (37515-51-8)
Fluoranthene (206-44-0)	3-Hydroxyfluoranthrene
Fluorene (86-73-7)	2-Hydroxyfluorene (2443-58-5) 3-Hydroxyfluorene (6344-67-8) 9-Hydroxyfluorene (484-17-3)
Phenanthrene (85-01-8)	1-Hydroxyphenanthrene (2433-56-9) 2-Hydroxyphenanthrene 3-Hydroxyphenanthrene (605-87-8) 4-Hydroxyphenanthrene (7651-86-7) 9-Hydroxyphenanthrene (484-17-3)
Pyrene (129-00-0)	1-Hydroxypyrene (5315-79-7)
Benzo[a]pyrene (50-32-8)	3-Hydroxybenzo[a]pyrene (13345-21-6)
Naphthalene (91-20-3)	1-Hydroxynaphthalene (90-15-3) 2-Hydroxynaphthalene (135-19-3)

benzo[b]fluoranthene, benzo[j]fluoranthene, benzo[k]fluoranthene, and indeno[1,2,3,cd]pyrene as possible human carcinogens. The NTP lists the following chemicals as reasonably anticipated to be human carcinogens: benz[a]anthracene, benzo[b]fluoranthene, benzo[j]fluoranthene, benzo[k]fluoranthene, benzo[a]pyrene, dibenz[a,h]acridine, dibenz[a,j]acridine, dibenz[a,h]anthracene, 7H-dibenzo-[c,g]carbazole, dibenzo[a,e]pyrene, dibenzo[a,h]pyrene, dibenzo[a,i]-pyrene, dibenzo[a,l]pyrene, indeno[1,2,3-cd]pyrene, and 5-methylchrysene (NTP, 2002). The U.S. EPA has classified as probable carcinogens the following: benz[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[k]fluoranthene, chrysene, dibenz[a,h]-anthracene, and indeno[1,2,3-cd]pyrene. Pyrene was reviewed by IARC and determined it not to be classifiable as to its human carcinogenicity. In 2005, NTP listed naphthalene as reasonably anticipated to be a human carcinogen (NTP, 2005). IARC, NTP, and U.S. EPA also list chemical mixtures (e.g., soot, coke-oven emissions, coal tars), which contain PAH chemicals, as known carcinogens.

Information about external exposure (i.e., environmental levels) and health effects is available in several reviews (Bostrom et al., 2002, Armstrong et al., 2004) as well as from ATSDR's Toxicological Profiles at <http://www.atsdr.cdc.gov/toxprofiles>.

Interpreting Levels of Urinary PAH Metabolites Reported in the Tables

Urinary levels of hydroxylated metabolites of PAHs were measured in a subsample of NHANES participants aged 6 years old and older. Participants were selected within the specified age range to be a representative sample of the U.S. population.

Measurement of these 22 metabolites reflects exposure to PAHs that has occurred within the previous few days. Some of the parent PAHs can produce more than one measurable urinary metabolite. Table 34 shows the relation between PAHs and their metabolites. The hydroxylated metabolites of the PAHs are excreted in human urine both as free hydroxylated metabolites and as hydroxylated metabolites conjugated to glucuronic acid and sulfate. Measurements provided in this *Report* include both free and conjugated forms of the hydroxylated metabolites.

Finding a measurable amount of one or more metabolites in the urine does not mean that the levels of the PAHs metabolites cause an adverse health effect. Whether levels of PAH metabolites at the levels reported here are

cause for health concern is not known; more research is needed. These data provide physicians with a reference range so that they can determine whether people have been exposed to higher levels of PAHs than are found in the general population. These data will help scientists plan and conduct research on exposure to PAHs and health effects.

1-Hydroxybenz[a]anthracene and 3- and 9-Hydroxybenz[a]anthracene

Metabolites of Benz[a]anthracene, CAS No. 56-55-3

Interpreting Levels of Urinary Benz[a]anthracene Metabolites Reported in the Tables

Urinary levels of 1-hydroxybenz[a]anthracene and combined levels of 3-hydroxybenz[a]-anthracene and 9-hydroxybenz[a]anthracene were measured in a subsample of NHANES 2001-2002 participants aged 6 years and older. Similar levels of 1- and 3-hydroxybenz[a]anthracene have been reported in a small sample of pre-school children (Wilson et al., 2003). A sampling of 24 adults and 24 children from low income households in North Carolina found higher urinary levels of urinary 1-hydroxybenz[a]anthracene and 3-hydroxybenz[a]-anthracene, exceeding five- to ten-fold the concentrations measured in the NHANES 1999-2002 subsamples (Chuang et al., 1999). Workers manufacturing fireproof stone had 3-hydroxybenz[a]anthracene levels that were

10-100 times higher than the levels that were found in the NHANES 1999-2002 subsamples (Gundel et al., 2000).

Table 34. 1-Hydroxybenz[a]anthracene

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 1999-2002.

	Survey years	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)				Sample size
			50th	75th	90th	95th	
Total, age 6 and older	99-00	*	< LOD	< LOD	< LOD	< LOD	2084
	01-02	*	< LOD	< LOD	< LOD	30.0 (22.0-36.0)	2748
Age group							
6-11 years	99-00	*	< LOD	< LOD	< LOD	< LOD	276
	01-02	*	< LOD	< LOD	13.0 (<LOD-30.0)	45.0 (19.0-56.0)	387
12-19 years	99-00	*	< LOD	< LOD	< LOD	< LOD	626
	01-02	*	< LOD	< LOD	4.00 (<LOD-19.0)	38.0 (10.0-68.0)	735
20 years and older	99-00	*	< LOD	< LOD	< LOD	< LOD	1182
	01-02	*	< LOD	< LOD	< LOD	26.0 (21.0-34.0)	1626
Gender							
Males	99-00	*	< LOD	< LOD	< LOD	< LOD	1004
	01-02	*	< LOD	< LOD	10.0 (<LOD-20.0)	30.0 (23.0-39.0)	1349
Females	99-00	*	< LOD	< LOD	< LOD	< LOD	1080
	01-02	*	< LOD	< LOD	< LOD	30.0 (15.0-40.0)	1399
Race/ethnicity							
Mexican Americans	99-00	*	< LOD	< LOD	< LOD	6.80 (<LOD-10.9)	667
	01-02	*	< LOD	< LOD	< LOD	21.0 (<LOD-38.0)	665
Non-Hispanic blacks	99-00	*	< LOD	< LOD	< LOD	5.20 (<LOD-7.20)	465
	01-02	*	< LOD	< LOD	30.0 (13.0-42.0)	59.0 (30.0-89.0)	692
Non-Hispanic whites	99-00	*	< LOD	< LOD	< LOD	< LOD	779
	01-02	*	< LOD	< LOD	< LOD	27.0 (20.0-37.0)	1208

< LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample. See Appendix A for LODs.

* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

Table 35. 1-Hydroxybenz[a]anthracene (creatinine corrected)

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 1999-2002.

	Survey years	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)				Sample size
			50th	75th	90th	95th	
Total, age 6 and older	99-00	*	< LOD	< LOD	< LOD	< LOD	2084
	01-02	*	< LOD	< LOD	< LOD	27.0 (19.6-32.4)	2748
Age group							
6-11 years	99-00	*	< LOD	< LOD	< LOD	< LOD	276
	01-02	*	< LOD	< LOD	21.5 (10.0-28.0)	34.0 (27.0-50.5)	387
12-19 years	99-00	*	< LOD	< LOD	< LOD	< LOD	626
	01-02	*	< LOD	< LOD	12.4 (6.83-24.8)	28.0 (14.8-38.0)	735
20 years and older	99-00	*	< LOD	< LOD	< LOD	< LOD	1182
	01-02	*	< LOD	< LOD	< LOD	24.5 (18.4-31.1)	1626
Gender							
Males	99-00	*	< LOD	< LOD	< LOD	< LOD	1004
	01-02	*	< LOD	< LOD	12.7 (10.2-17.0)	24.8 (18.4-33.8)	1349
Females	99-00	*	< LOD	< LOD	< LOD	< LOD	1080
	01-02	*	< LOD	< LOD	< LOD	27.0 (17.5-33.9)	1399
Race/ethnicity							
Mexican Americans	99-00	*	< LOD	< LOD	< LOD	15.7 (9.43-18.3)	667
	01-02	*	< LOD	< LOD	< LOD	21.5 (14.1-33.3)	665
Non-Hispanic blacks	99-00	*	< LOD	< LOD	< LOD	7.36 (5.41-11.0)	465
	01-02	*	< LOD	< LOD	17.5 (10.7-28.1)	33.9 (17.5-61.6)	692
Non-Hispanic whites	99-00	*	< LOD	< LOD	< LOD	< LOD	779
	01-02	*	< LOD	< LOD	< LOD	28.0 (18.7-32.7)	1208

< LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample. See Appendix A for LODs.

* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

Table 36. 3- and 9-Hydroxybenz[a]anthracene

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 1999-2002.

	Survey years	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)				Sample size
			50th	75th	90th	95th	
Total, age 6 and older	99-00	*	< LOD	< LOD	7.50 (6.00-9.90)	11.6 (8.40-15.6)	2152
	01-02	*	< LOD	< LOD	11.0 (<LOD-15.0)	24.0 (19.0-31.0)	2748
Age group							
6-11 years	99-00	*	< LOD	7.70 (<LOD-11.9)	14.4 (7.70-49.8)	32.0 (9.50-71.0)	285
	01-02	*	< LOD	< LOD	< LOD	14.0 (11.0-21.0)	387
12-19 years	99-00	*	< LOD	6.20 (<LOD-7.50)	10.5 (8.80-13.8)	14.9 (11.4-16.8)	652
	01-02	*	< LOD	< LOD	14.0 (<LOD-18.0)	28.0 (18.0-42.0)	735
20 years and older	99-00	*	< LOD	< LOD	5.80 (<LOD-7.20)	8.80 (6.50-11.8)	1215
	01-02	*	< LOD	< LOD	11.0 (<LOD-16.0)	23.0 (18.0-31.0)	1626
Gender							
Males	99-00	*	< LOD	< LOD	7.90 (5.70-12.6)	13.5 (9.20-18.8)	1033
	01-02	*	< LOD	< LOD	15.0 (12.0-18.0)	25.0 (20.0-31.0)	1349
Females	99-00	*	< LOD	< LOD	7.10 (6.00-9.10)	10.3 (8.90-11.9)	1119
	01-02	*	< LOD	< LOD	< LOD	21.0 (14.0-35.0)	1399
Race/ethnicity							
Mexican Americans	99-00	*	< LOD	< LOD	7.70 (6.80-8.90)	11.1 (8.10-14.2)	688
	01-02	*	< LOD	< LOD	11.0 (<LOD-16.0)	23.0 (16.0-31.0)	665
Non-Hispanic blacks	99-00	*	< LOD	< LOD	7.60 (5.80-11.5)	11.6 (7.30-19.0)	488
	01-02	*	< LOD	< LOD	18.0 (15.0-25.0)	35.0 (22.0-46.0)	692
Non-Hispanic whites	99-00	*	< LOD	< LOD	7.60 (5.60-10.3)	11.8 (7.70-18.0)	793
	01-02	*	< LOD	< LOD	11.0 (<LOD-18.0)	23.0 (18.0-36.0)	1208

< LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample. See Appendix A for LODs.

* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

Table 37. 3- and 9-Hydroxybenz[a]anthracene (creatinine corrected)

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 1999-2002.

	Survey years	Geometric mean (95% conf. interval)		Selected percentiles (95% confidence interval)			Sample size
		50th	75th	90th	95th		
Total, age 6 and older	99-00	*	< LOD	< LOD	12.2 (10.1-14.6)	17.6 (15.7-21.1)	2152
	01-02	*	< LOD	< LOD	21.4 (19.2-23.7)	31.8 (28.4-35.5)	2748
Age group							
6-11 years	99-00	*	< LOD	9.61 (6.63-14.6)	18.1 (10.3-29.6)	23.6 (12.8-40.5)	285
	01-02	*	< LOD	< LOD	< LOD	29.6 (23.7-39.8)	387
12-19 years	99-00	*	< LOD	5.09 (4.42-5.94)	7.69 (6.44-8.64)	10.0 (8.50-11.9)	652
	01-02	*	< LOD	< LOD	18.2 (15.2-24.8)	29.1 (21.5-50.7)	735
20 years and older	99-00	*	< LOD	< LOD	12.2 (10.2-14.3)	17.4 (15.2-21.1)	1215
	01-02	*	< LOD	< LOD	21.5 (20.3-24.5)	32.3 (28.1-35.5)	1626
Gender							
Males	99-00	*	< LOD	< LOD	9.77 (8.09-12.7)	14.7 (10.7-19.0)	1033
	01-02	*	< LOD	< LOD	18.7 (15.6-21.9)	26.3 (21.5-35.3)	1349
Females	99-00	*	< LOD	< LOD	14.1 (12.3-16.5)	21.1 (16.5-22.4)	1119
	01-02	*	< LOD	< LOD	< LOD	33.8 (29.8-39.8)	1399
Race/ethnicity							
Mexican Americans	99-00	*	< LOD	< LOD	10.8 (8.84-15.5)	18.1 (11.9-21.6)	688
	01-02	*	< LOD	< LOD	21.5 (17.2-28.4)	32.3 (27.3-36.3)	665
Non-Hispanic blacks	99-00	*	< LOD	< LOD	6.77 (5.76-9.05)	10.9 (7.45-14.1)	488
	01-02	*	< LOD	< LOD	17.6 (14.5-22.2)	28.4 (21.5-41.2)	692
Non-Hispanic whites	99-00	*	< LOD	< LOD	13.1 (10.3-16.5)	19.0 (16.5-22.4)	793
	01-02	*	< LOD	< LOD	23.7 (20.9-25.6)	33.8 (29.6-37.4)	1208

< LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample. See Appendix A for LODs.

* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

1-Hydroxybenzo[c]phenanthrene, 2-Hydroxybenzo[c]phenanthrene, and 3-Hydroxybenzo[c]phenanthrene

Metabolites of Benzo[c]phenanthrene, CAS No. 195-19-7

Urinary levels of 1-hydroxybenzo[c]phenanthrene, 2-hydroxybenzo-[c]phenanthrene, and 3-hydroxybenzo[c]phenanthrene were measured in a subsample of NHANES participants aged 6 years and older.

Table 38. 1-Hydroxybenzo[c]phenanthrene

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 1999-2002.

	Survey years	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)				Sample size
			50th	75th	90th	95th	
Total, age 6 and older	99-00	*	< LOD	8.20 (<LOD-13.1)	17.2 (10.8-31.3)	31.0 (19.0-47.2)	2200
	01-02	*	< LOD	< LOD	< LOD	34.0 (16.0-54.0)	2732
Age group							
6-11 years	99-00	*	< LOD	9.10 (<LOD-17.5)	17.0 (9.20-40.1)	32.1 (13.8-254)	297
	01-02	*	< LOD	< LOD	< LOD	15.0 (<LOD-35.0)	385
12-19 years	99-00	*	< LOD	9.50 (7.10-13.2)	18.0 (12.4-31.2)	31.2 (16.9-48.1)	665
	01-02	*	< LOD	< LOD	< LOD	29.0 (11.0-64.0)	728
20 years and older	99-00	*	< LOD	8.10 (<LOD-12.8)	16.9 (10.5-31.0)	30.3 (19.4-47.2)	1238
	01-02	*	< LOD	< LOD	4.00 (<LOD-19.0)	37.0 (16.0-79.0)	1619
Gender							
Males	99-00	*	< LOD	8.40 (<LOD-13.8)	18.0 (11.5-33.6)	35.4 (25.2-47.2)	1054
	01-02	*	< LOD	< LOD	< LOD	19.0 (5.00-33.0)	1340
Females	99-00	*	< LOD	8.20 (<LOD-13.3)	16.5 (9.80-25.8)	24.7 (15.2-47.2)	1146
	01-02	*	< LOD	< LOD	13.0 (<LOD-37.0)	51.0 (26.0-94.0)	1392
Race/ethnicity							
Mexican Americans	99-00	*	< LOD	12.9 (7.40-20.2)	21.9 (15.2-32.4)	32.4 (23.3-47.5)	716
	01-02	*	< LOD	< LOD	11.0 (<LOD-84.0)	52.0 (9.00-105)	659
Non-Hispanic blacks	99-00	*	< LOD	7.60 (<LOD-9.90)	12.8 (8.20-32.4)	30.3 (11.0-49.2)	497
	01-02	*	< LOD	< LOD	< LOD	21.0 (<LOD-72.0)	687
Non-Hispanic whites	99-00	*	< LOD	8.40 (<LOD-14.4)	17.0 (10.0-32.9)	29.4 (16.7-58.7)	806
	01-02	*	< LOD	< LOD	< LOD	35.0 (15.0-83.0)	1205

< LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample. See Appendix A for LODs.

* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

Table 39. 1-Hydroxybenzo[c]phenanthrene (creatinine corrected)

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 1999-2002.

	Survey years	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)				Sample size
			50th	75th	90th	95th	
Total, age 6 and older	99-00	*	< LOD	10.1 (7.69-13.3)	22.8 (15.7-30.0)	36.1 (23.5-62.3)	2200
	01-02	*	< LOD	< LOD	< LOD	41.3 (21.0-70.8)	2732
Age group							
6-11 years	99-00	*	< LOD	9.73 (7.29-17.7)	22.7 (10.7-39.6)	32.8 (20.5-80.5)	297
	01-02	*	< LOD	< LOD	< LOD	28.3 (7.00-114)	385
12-19 years	99-00	*	< LOD	7.69 (5.73-10.2)	16.3 (11.5-22.0)	24.3 (16.3-34.0)	665
	01-02	*	< LOD	< LOD	< LOD	21.5 (15.0-46.7)	728
20 years and older	99-00	*	< LOD	10.5 (7.88-13.8)	23.5 (15.4-33.3)	37.4 (23.5-80.7)	1238
	01-02	*	< LOD	< LOD	12.4 (8.50-20.7)	45.9 (20.7-76.5)	1619
Gender							
Males	99-00	*	< LOD	8.61 (6.67-11.1)	18.6 (12.7-26.7)	28.8 (22.8-37.1)	1054
	01-02	*	< LOD	< LOD	< LOD	18.7 (12.2-37.2)	1340
Females	99-00	*	< LOD	11.8 (8.24-17.5)	25.1 (15.4-41.1)	40.4 (21.1-93.3)	1146
	01-02	*	< LOD	< LOD	19.3 (9.55-45.5)	69.6 (33.3-103)	1392
Race/ethnicity							
Mexican Americans	99-00	*	< LOD	12.3 (9.47-17.0)	26.7 (19.0-36.3)	37.1 (27.1-50.0)	716
	01-02	*	< LOD	< LOD	16.2 (5.12-54.5)	42.0 (12.4-106)	659
Non-Hispanic blacks	99-00	*	< LOD	5.75 (4.32-7.86)	11.8 (7.80-20.5)	21.1 (11.4-40.5)	497
	01-02	*	< LOD	< LOD	< LOD	14.0 (5.38-78.5)	687
Non-Hispanic whites	99-00	*	< LOD	10.4 (7.84-14.3)	23.9 (15.4-36.4)	37.4 (22.8-86.9)	806
	01-02	*	< LOD	< LOD	< LOD	45.7 (19.1-87.5)	1205

< LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample. See Appendix A for LODs.

* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

Table 40. 2-Hydroxybenzo[c]phenanthrene

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 1999-2002.

	Survey years	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)				Sample size
			50th	75th	90th	95th	
Total, age 6 and older	99-00	*	< LOD	< LOD	14.3 (9.60-19.6)	21.2 (16.5-28.1)	2175
	01-02	*	< LOD	< LOD	< LOD	13.0 (6.00-20.0)	2748
Age group							
6-11 years	99-00	*	< LOD	7.00 (<LOD-16.2)	19.9 (11.6-34.9)	30.2 (14.2-47.2)	285
	01-02	*	< LOD	< LOD	< LOD	< LOD	387
12-19 years	99-00	*	< LOD	< LOD	14.0 (8.90-20.0)	20.0 (14.6-32.3)	657
	01-02	*	< LOD	< LOD	< LOD	< LOD	735
20 years and older	99-00	*	< LOD	< LOD	13.5 (8.50-21.2)	20.1 (14.0-29.4)	1233
	01-02	*	< LOD	< LOD	< LOD	16.0 (9.00-24.0)	1626
Gender							
Males	99-00	*	< LOD	7.00 (<LOD-10.9)	16.9 (12.2-23.8)	29.0 (22.2-34.9)	1046
	01-02	*	< LOD	< LOD	< LOD	13.0 (6.00-20.0)	1349
Females	99-00	*	< LOD	< LOD	11.9 (8.20-17.5)	17.0 (12.8-22.0)	1129
	01-02	*	< LOD	< LOD	< LOD	13.0 (<LOD-27.0)	1399
Race/ethnicity							
Mexican Americans	99-00	*	< LOD	< LOD	12.2 (8.10-17.1)	17.0 (12.2-28.9)	686
	01-02	*	< LOD	< LOD	< LOD	15.0 (<LOD-42.0)	665
Non-Hispanic blacks	99-00	*	< LOD	10.0 (<LOD-16.6)	20.0 (14.4-34.3)	34.3 (19.0-51.6)	495
	01-02	*	< LOD	< LOD	< LOD	18.0 (<LOD-23.0)	692
Non-Hispanic whites	99-00	*	< LOD	< LOD	13.5 (8.40-20.5)	21.2 (15.0-29.4)	810
	01-02	*	< LOD	< LOD	< LOD	15.0 (<LOD-22.0)	1208

< LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample. See Appendix A for LODs.

* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

Table 41. 2-Hydroxybenzo[c]phenanthrene (creatinine corrected)

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 1999-2002.

	Survey years	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)				Sample size
			50th	75th	90th	95th	
Total, age 6 and older	99-00	*	< LOD	< LOD	20.0 (16.0-23.7)	28.2 (23.1-30.9)	2175
	01-02	*	< LOD	< LOD	< LOD	20.3 (15.9-23.3)	2748
Age group							
6-11 years	99-00	*	< LOD	11.4 (9.53-13.0)	23.1 (12.3-32.0)	34.3 (20.0-67.3)	285
	01-02	*	< LOD	< LOD	< LOD	< LOD	387
12-19 years	99-00	*	< LOD	< LOD	11.7 (8.77-15.0)	16.4 (11.7-26.1)	657
	01-02	*	< LOD	< LOD	< LOD	< LOD	735
20 years and older	99-00	*	< LOD	< LOD	20.9 (16.0-26.7)	28.6 (25.3-32.8)	1233
	01-02	*	< LOD	< LOD	< LOD	21.4 (16.7-29.1)	1626
Gender							
Males	99-00	*	< LOD	8.42 (6.96-10.9)	17.3 (13.3-23.1)	25.3 (19.3-34.3)	1046
	01-02	*	< LOD	< LOD	< LOD	17.5 (13.5-23.3)	1349
Females	99-00	*	< LOD	< LOD	20.9 (16.6-26.7)	30.0 (26.7-30.9)	1129
	01-02	*	< LOD	< LOD	< LOD	21.9 (16.7-35.0)	1399
Race/ethnicity							
Mexican Americans	99-00	*	< LOD	< LOD	15.5 (11.7-20.8)	22.9 (16.6-25.0)	686
	01-02	*	< LOD	< LOD	< LOD	23.3 (14.0-53.7)	665
Non-Hispanic blacks	99-00	*	< LOD	7.38 (5.57-11.7)	16.7 (11.7-22.3)	23.3 (18.0-33.0)	495
	01-02	*	< LOD	< LOD	< LOD	13.2 (10.9-18.4)	692
Non-Hispanic whites	99-00	*	< LOD	< LOD	20.8 (16.1-25.3)	28.6 (25.3-32.0)	810
	01-02	*	< LOD	< LOD	< LOD	21.9 (16.7-28.2)	1208

< LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample. See Appendix A for LODs.

* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

Table 42. 3-Hydroxybenzo[c]phenanthrene

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 1999-2002.

	Survey years	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)				Sample size
			50th	75th	90th	95th	
Total, age 6 and older	99-00	*	< LOD	< LOD	< LOD	< LOD	2172
	01-02	*	< LOD	< LOD	< LOD	11.0 (8.00-16.0)	2748
Age group							
6-11 years	99-00	*	< LOD	< LOD	< LOD	< LOD	287
	01-02	*	< LOD	< LOD	8.00 (<LOD-13.0)	13.0 (8.00-24.0)	387
12-19 years	99-00	*	< LOD	< LOD	< LOD	< LOD	657
	01-02	*	< LOD	< LOD	< LOD	12.0 (<LOD-21.0)	735
20 years and older	99-00	*	< LOD	< LOD	< LOD	< LOD	1228
	01-02	*	< LOD	< LOD	< LOD	11.0 (8.00-16.0)	1626
Gender							
Males	99-00	*	< LOD	< LOD	< LOD	< LOD	1045
	01-02	*	< LOD	< LOD	7.00 (<LOD-11.0)	11.0 (9.00-15.0)	1349
Females	99-00	*	< LOD	< LOD	< LOD	< LOD	1127
	01-02	*	< LOD	< LOD	< LOD	12.0 (6.00-18.0)	1399
Race/ethnicity							
Mexican Americans	99-00	*	< LOD	< LOD	< LOD	< LOD	689
	01-02	*	< LOD	< LOD	< LOD	14.0 (8.00-21.0)	665
Non-Hispanic blacks	99-00	*	< LOD	< LOD	< LOD	< LOD	491
	01-02	*	< LOD	< LOD	< LOD	14.0 (<LOD-26.0)	692
Non-Hispanic whites	99-00	*	< LOD	< LOD	< LOD	< LOD	807
	01-02	*	< LOD	< LOD	< LOD	11.0 (8.00-15.0)	1208

< LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample. See Appendix A for LODs.

* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

Table 43. 3-Hydroxybenzo[c]phenanthrene (creatinine corrected)

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 1999-2002.

	Survey years	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)				Sample size
			50th	75th	90th	95th	
Total, age 6 and older	99-00	*	< LOD	< LOD	< LOD	< LOD	2172
	01-02	*	< LOD	< LOD	< LOD	15.9 (14.6-16.7)	2748
Age group							
6-11 years	99-00	*	< LOD	< LOD	< LOD	< LOD	287
	01-02	*	< LOD	< LOD	10.9 (8.75-14.0)	14.6 (12.5-15.9)	387
12-19 years	99-00	*	< LOD	< LOD	< LOD	< LOD	657
	01-02	*	< LOD	< LOD	< LOD	13.1 (10.0-17.5)	735
20 years and older	99-00	*	< LOD	< LOD	< LOD	< LOD	1228
	01-02	*	< LOD	< LOD	< LOD	15.9 (14.3-17.1)	1626
Gender							
Males	99-00	*	< LOD	< LOD	< LOD	< LOD	1045
	01-02	*	< LOD	< LOD	9.46 (8.54-10.5)	12.5 (11.3-15.9)	1349
Females	99-00	*	< LOD	< LOD	< LOD	< LOD	1127
	01-02	*	< LOD	< LOD	< LOD	16.7 (15.9-19.6)	1399
Race/ethnicity							
Mexican Americans	99-00	*	< LOD	< LOD	< LOD	< LOD	689
	01-02	*	< LOD	< LOD	< LOD	17.5 (14.0-23.3)	665
Non-Hispanic blacks	99-00	*	< LOD	< LOD	< LOD	< LOD	491
	01-02	*	< LOD	< LOD	< LOD	13.4 (10.7-18.4)	692
Non-Hispanic whites	99-00	*	< LOD	< LOD	< LOD	< LOD	807
	01-02	*	< LOD	< LOD	< LOD	15.9 (14.3-16.7)	1208

< LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample. See Appendix A for LODs.

* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

1-Hydroxychrysene, 2-Hydroxychrysene 3-Hydroxychrysene, 4-Hydroxychrysene, and 6-Hydroxychrysene

Metabolites of Chrysene, CAS No. 218-01-9

Interpreting Levels of Urinary Chrysene Metabolites Reported in the Tables

Urinary levels of 1-hydroxychrysene, 2-hydroxychrysene 3-hydroxychrysene, 4-hydroxychrysene, and 6-hydroxychrysene were measured in a subsample of NHANES 2001-2002 participants aged 6 years and older. Similar levels of 6-hydroxychrysene have been reported in preschool children (Wilson et al., 2003). A sampling of 24 adults and 24 children from low income households in North Carolina found higher levels of urinary 6-hydroxychrysene, exceeding five- to ten-fold the concentrations measured in the NHANES 1999-2002 subsamples (Chuang et al., 1999).

Table 44. 1-Hydroxychrysene

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 2001-2002.

	Survey years	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)				Sample size
			50th	75th	90th	95th	
Total, age 6 and older	01-02	*	< LOD	13.0 (<LOD-27.0)	64.0 (46.0-78.0)	105 (85.0-138)	2748
Age group							
6-11 years	01-02	*	< LOD	< LOD	35.0 (19.0-52.0)	69.0 (37.0-83.0)	387
12-19 years	01-02	*	< LOD	8.00 (<LOD-23.0)	46.0 (31.0-62.0)	71.0 (50.0-119)	735
20 years and older	01-02	*	< LOD	17.0 (<LOD-30.0)	71.0 (53.0-87.0)	116 (92.0-147)	1626
Gender							
Males	01-02	*	< LOD	23.0 (<LOD-38.0)	73.0 (55.0-89.0)	107 (87.0-152)	1349
Females	01-02	*	< LOD	5.00 (<LOD-20.0)	49.0 (31.0-71.0)	92.0 (74.0-134)	1399
Race/ethnicity							
Mexican Americans	01-02	*	< LOD	< LOD	62.0 (31.0-102)	104 (74.0-206)	665
Non-Hispanic blacks	01-02	*	< LOD	19.0 (<LOD-47.0)	78.0 (53.0-103)	135 (81.0-190)	692
Non-Hispanic whites	01-02	*	< LOD	12.0 (<LOD-28.0)	60.0 (42.0-79.0)	105 (75.0-143)	1208

< LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample. See Appendix A for LODs.

* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

Table 45. 1-Hydroxychrysene (creatinine corrected)

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 2001-2002.

	Survey years	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)				Sample size
			50th	75th	90th	95th	
Total, age 6 and older	01-02	*	< LOD	17.1 (11.3-25.0)	50.0 (41.2-59.7)	89.2 (71.4-104)	2748
Age group							
6-11 years	01-02	*	< LOD	< LOD	42.6 (22.2-54.7)	58.1 (47.0-74.2)	387
12-19 years	01-02	*	< LOD	13.3 (7.61-18.6)	35.0 (28.3-41.0)	49.3 (37.4-65.7)	735
20 years and older	01-02	*	< LOD	18.1 (11.7-28.5)	55.9 (42.8-70.2)	103 (78.9-120)	1626
Gender							
Males	01-02	*	< LOD	19.4 (11.7-28.8)	50.0 (41.1-57.7)	86.4 (59.7-109)	1349
Females	01-02	*	< LOD	15.9 (10.6-23.3)	50.0 (38.9-66.0)	91.5 (69.2-126)	1399
Race/ethnicity							
Mexican Americans	01-02	*	< LOD	< LOD	58.2 (36.3-92.5)	108 (61.8-147)	665
Non-Hispanic blacks	01-02	*	< LOD	18.3 (6.48-33.9)	56.6 (37.9-83.0)	106 (62.4-154)	692
Non-Hispanic whites	01-02	*	< LOD	16.5 (10.9-24.7)	47.3 (38.4-59.4)	91.5 (68.6-107)	1208

< LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample. See Appendix A for LODs.

* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

Table 46. 2-Hydroxychrysene

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 2001-2002.

	Survey years	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)				Sample size
			50th	75th	90th	95th	
Total, age 6 and older	01-02	*	< LOD	< LOD	11.0 (<LOD-26.0)	31.0 (14.0-45.0)	2748
Age group							
6-11 years	01-02	*	< LOD	< LOD	22.0 (<LOD-43.0)	39.0 (13.0-49.0)	387
12-19 years	01-02	*	< LOD	< LOD	9.00 (<LOD-32.0)	32.0 (<LOD-49.0)	735
20 years and older	01-02	*	< LOD	< LOD	10.0 (<LOD-23.0)	32.0 (12.0-46.0)	1626
Gender							
Males	01-02	*	< LOD	< LOD	12.0 (<LOD-28.0)	34.0 (13.0-50.0)	1349
Females	01-02	*	< LOD	< LOD	9.00 (<LOD-22.0)	31.0 (12.0-43.0)	1399
Race/ethnicity							
Mexican Americans	01-02	*	< LOD	< LOD	< LOD	15.0 (<LOD-39.0)	665
Non-Hispanic blacks	01-02	*	< LOD	< LOD	20.0 (<LOD-43.0)	43.0 (17.0-65.0)	692
Non-Hispanic whites	01-02	*	< LOD	< LOD	9.00 (<LOD-24.0)	27.0 (11.0-45.0)	1208

< LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample. See Appendix A for LODs.

* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

Table 47. 2-Hydroxychrysene (creatinine corrected)

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 2001-2002.

	Survey years	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)				Sample size
			50th	75th	90th	95th	
Total, age 6 and older	01-02	*	< LOD	< LOD	17.5 (12.1-24.5)	27.8 (20.9-35.0)	2748
Age group							
6-11 years	01-02	*	< LOD	< LOD	21.9 (17.2-29.0)	29.9 (22.0-34.2)	387
12-19 years	01-02	*	< LOD	< LOD	14.3 (8.14-18.5)	24.1 (15.2-35.0)	735
20 years and older	01-02	*	< LOD	< LOD	17.6 (11.7-25.2)	27.8 (20.6-38.9)	1626
Gender							
Males	01-02	*	< LOD	< LOD	17.3 (9.72-24.9)	26.3 (18.2-34.2)	1349
Females	01-02	*	< LOD	< LOD	18.2 (14.0-24.5)	30.2 (21.7-39.4)	1399
Race/ethnicity							
Mexican Americans	01-02	*	< LOD	< LOD	< LOD	21.8 (15.9-31.3)	665
Non-Hispanic blacks	01-02	*	< LOD	< LOD	19.5 (7.50-32.4)	30.8 (18.4-45.5)	692
Non-Hispanic whites	01-02	*	< LOD	< LOD	17.3 (11.7-25.0)	27.1 (20.3-35.0)	1208

< LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample. See Appendix A for LODs.

* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

Table 48. 3-Hydroxychrysene

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 1999-2002.

	Survey years	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)				Sample size
			50th	75th	90th	95th	
Total, age 6 and older	99-00	*	< LOD	< LOD	< LOD	< LOD	2233
	01-02	*	< LOD	< LOD	27.0 (24.0-31.0)	42.0 (36.0-46.0)	2748
Age group							
6-11 years	99-00	*	< LOD	< LOD	< LOD	11.0 (<LOD-44.8)	300
	01-02	*	< LOD	< LOD	21.0 (15.0-38.0)	42.0 (22.0-62.0)	387
12-19 years	99-00	*	< LOD	< LOD	< LOD	11.3 (<LOD-17.2)	674
	01-02	*	< LOD	< LOD	23.0 (18.0-30.0)	37.0 (27.0-39.0)	735
20 years and older	99-00	*	< LOD	< LOD	< LOD	< LOD	1259
	01-02	*	< LOD	< LOD	29.0 (25.0-31.0)	43.0 (37.0-47.0)	1626
Gender							
Males	99-00	*	< LOD	< LOD	< LOD	10.1 (<LOD-17.7)	1067
	01-02	*	< LOD	< LOD	30.0 (25.0-37.0)	45.0 (37.0-54.0)	1349
Females	99-00	*	< LOD	< LOD	< LOD	< LOD	1166
	01-02	*	< LOD	< LOD	25.0 (20.0-30.0)	35.0 (30.0-44.0)	1399
Race/ethnicity							
Mexican Americans	99-00	*	< LOD	< LOD	< LOD	10.8 (<LOD-14.5)	722
	01-02	*	< LOD	< LOD	24.0 (18.0-28.0)	30.0 (27.0-38.0)	665
Non-Hispanic blacks	99-00	*	< LOD	< LOD	< LOD	< LOD	515
	01-02	*	< LOD	< LOD	25.0 (16.0-35.0)	43.0 (28.0-63.0)	692
Non-Hispanic whites	99-00	*	< LOD	< LOD	< LOD	< LOD	807
	01-02	*	< LOD	9.00 (<LOD-15.0)	30.0 (25.0-34.0)	44.0 (36.0-49.0)	1208

< LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample. See Appendix A for LODs.

* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

Table 49. 3-Hydroxychrysene (creatinine corrected)

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 1999-2002.

	Survey years	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)				Sample size
			50th	75th	90th	95th	
Total, age 6 and older	99-00	*	< LOD	< LOD	< LOD	< LOD	2233
	01-02	*	< LOD	< LOD	35.0 (27.1-41.5)	56.8 (47.4-62.5)	2748
Age group							
6-11 years	99-00	*	< LOD	< LOD	< LOD	26.9 (17.5-46.2)	300
	01-02	*	< LOD	< LOD	36.8 (23.8-62.5)	67.3 (36.7-89.9)	387
12-19 years	99-00	*	< LOD	< LOD	< LOD	17.3 (13.7-21.9)	674
	01-02	*	< LOD	< LOD	28.2 (20.0-40.7)	43.8 (33.8-57.0)	735
20 years and older	99-00	*	< LOD	< LOD	< LOD	< LOD	1259
	01-02	*	< LOD	< LOD	35.8 (26.7-44.6)	57.8 (50.0-63.6)	1626
Gender							
Males	99-00	*	< LOD	< LOD	< LOD	20.6 (17.5-29.2)	1067
	01-02	*	< LOD	< LOD	28.2 (24.1-35.0)	47.6 (40.9-57.0)	1349
Females	99-00	*	< LOD	< LOD	< LOD	< LOD	1166
	01-02	*	< LOD	< LOD	40.9 (30.2-50.0)	65.0 (51.6-83.0)	1399
Race/ethnicity							
Mexican Americans	99-00	*	< LOD	< LOD	< LOD	33.3 (21.9-37.1)	722
	01-02	*	< LOD	< LOD	28.4 (24.4-35.8)	42.0 (30.0-54.0)	665
Non-Hispanic blacks	99-00	*	< LOD	< LOD	< LOD	< LOD	515
	01-02	*	< LOD	< LOD	22.8 (15.1-30.5)	35.0 (23.0-62.5)	692
Non-Hispanic whites	99-00	*	< LOD	< LOD	< LOD	< LOD	807
	01-02	*	< LOD	16.3 (13.9-18.4)	40.6 (31.8-47.4)	61.8 (51.5-70.2)	1208

< LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample. See Appendix A for LODs.

* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

Table 50. 4-Hydroxychrysene

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 2001-2002.

	Survey years	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)				Sample size
			50th	75th	90th	95th	
Total, age 6 and older	01-02	*	< LOD	< LOD	< LOD	< LOD	2748
Age group							
6-11 years	01-02	*	< LOD	< LOD	< LOD	5.00 (<LOD-11.0)	387
12-19 years	01-02	*	< LOD	< LOD	< LOD	< LOD	735
20 years and older	01-02	*	< LOD	< LOD	< LOD	< LOD	1626
Gender							
Males	01-02	*	< LOD	< LOD	< LOD	< LOD	1349
Females	01-02	*	< LOD	< LOD	< LOD	< LOD	1399
Race/ethnicity							
Mexican Americans	01-02	*	< LOD	< LOD	< LOD	< LOD	665
Non-Hispanic blacks	01-02	*	< LOD	< LOD	< LOD	13.0 (4.00-18.0)	692
Non-Hispanic whites	01-02	*	< LOD	< LOD	< LOD	< LOD	1208

< LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample. See Appendix A for LODs.

* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

Table 51. 4-Hydroxychrysene (creatinine corrected)

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 2001-2002.

	Survey years	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)				Sample size
			50th	75th	90th	95th	
Total, age 6 and older	01-02	*	< LOD	< LOD	< LOD	< LOD	2748
Age group							
6-11 years	01-02	*	< LOD	< LOD	< LOD	9.55 (7.24-12.4)	387
12-19 years	01-02	*	< LOD	< LOD	< LOD	< LOD	735
20 years and older	01-02	*	< LOD	< LOD	< LOD	< LOD	1626
Gender							
Males	01-02	*	< LOD	< LOD	< LOD	< LOD	1349
Females	01-02	*	< LOD	< LOD	< LOD	< LOD	1399
Race/ethnicity							
Mexican Americans	01-02	*	< LOD	< LOD	< LOD	< LOD	665
Non-Hispanic blacks	01-02	*	< LOD	< LOD	< LOD	9.00 (7.49-12.2)	692
Non-Hispanic whites	01-02	*	< LOD	< LOD	< LOD	< LOD	1208

< LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample. See Appendix A for LODs.

* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

Table 52. 6-Hydroxychrysene

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 1999-2002.

	Survey years	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)				Sample size
			50th	75th	90th	95th	
Total, age 6 and older	99-00	*	< LOD	< LOD	4.50 (<LOD-5.30)	6.00 (5.30-6.80)	2279
	01-02	*	< LOD	7.00 (<LOD-13.0)	43.0 (32.0-55.0)	77.0 (57.0-101)	2736
Age group							
6-11 years	99-00	*	< LOD	< LOD	5.00 (<LOD-5.90)	6.10 (5.70-7.60)	298
	01-02	*	< LOD	10.0 (<LOD-20.0)	32.0 (25.0-52.0)	68.0 (34.0-115)	386
12-19 years	99-00	*	< LOD	< LOD	5.70 (4.30-7.50)	7.70 (5.00-11.2)	689
	01-02	*	< LOD	10.0 (6.00-16.0)	46.0 (29.0-59.0)	79.0 (59.0-105)	728
20 years and older	99-00	*	< LOD	< LOD	4.40 (<LOD-5.10)	5.80 (4.90-6.60)	1292
	01-02	*	< LOD	7.00 (<LOD-13.0)	44.0 (32.0-60.0)	77.0 (57.0-103)	1622
Gender							
Males	99-00	*	< LOD	< LOD	4.80 (<LOD-5.70)	6.40 (5.40-7.70)	1091
	01-02	*	< LOD	13.0 (7.00-18.0)	55.0 (41.0-67.0)	101 (67.0-123)	1341
Females	99-00	*	< LOD	< LOD	4.20 (<LOD-5.10)	5.80 (4.50-7.30)	1188
	01-02	*	< LOD	< LOD	33.0 (22.0-46.0)	59.0 (44.0-78.0)	1395
Race/ethnicity							
Mexican Americans	99-00	*	< LOD	< LOD	4.70 (3.70-5.10)	6.00 (4.90-8.10)	749
	01-02	*	< LOD	16.0 (7.00-20.0)	48.0 (38.0-63.0)	84.0 (63.0-117)	664
Non-Hispanic blacks	99-00	*	< LOD	< LOD	4.90 (<LOD-6.60)	6.80 (4.70-9.50)	515
	01-02	*	< LOD	9.00 (<LOD-14.0)	61.0 (40.0-88.0)	112 (77.0-134)	683
Non-Hispanic whites	99-00	*	< LOD	< LOD	4.50 (<LOD-5.50)	5.90 (5.50-6.60)	827
	01-02	*	< LOD	9.00 (<LOD-15.0)	42.0 (29.0-58.0)	73.0 (52.0-107)	1206

< LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample. See Appendix A for LODs.

* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

Table 53. 6-Hydroxychrysene (creatinine corrected)

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 1999-2002.

	Survey years	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)				Sample size
			50th	75th	90th	95th	
Total, age 6 and older	99-00	*	< LOD	< LOD	8.05 (7.06-9.15)	12.6 (10.4-13.3)	2279
	01-02	*	< LOD	9.26 (6.36-13.8)	36.9 (28.0-46.0)	61.5 (47.7-76.4)	2736
Age group							
6-11 years	99-00	*	< LOD	< LOD	7.74 (5.11-13.1)	11.0 (8.09-24.5)	298
	01-02	*	< LOD	12.2 (5.00-18.9)	39.4 (24.5-62.7)	80.6 (40.0-115)	386
12-19 years	99-00	*	< LOD	< LOD	6.32 (4.61-9.35)	9.23 (5.83-11.7)	689
	01-02	*	< LOD	9.05 (6.49-12.7)	36.0 (21.1-46.9)	62.7 (44.3-97.6)	728
20 years and older	99-00	*	< LOD	< LOD	8.18 (7.07-9.60)	13.3 (11.4-14.1)	1292
	01-02	*	< LOD	8.65 (5.19-14.2)	36.4 (26.7-46.2)	60.7 (46.0-76.0)	1622
Gender							
Males	99-00	*	< LOD	< LOD	6.67 (5.22-8.51)	9.23 (8.28-11.7)	1091
	01-02	*	< LOD	12.0 (8.24-15.5)	41.5 (30.4-56.1)	64.4 (52.2-97.2)	1341
Females	99-00	*	< LOD	< LOD	9.88 (8.00-11.4)	14.1 (12.6-17.1)	1188
	01-02	*	< LOD	< LOD	32.5 (22.6-44.6)	50.8 (42.6-68.8)	1395
Race/ethnicity							
Mexican Americans	99-00	*	< LOD	< LOD	8.05 (5.45-11.4)	13.3 (7.74-24.2)	749
	01-02	*	< LOD	14.8 (8.29-20.8)	48.5 (33.6-63.4)	75.0 (50.3-123)	664
Non-Hispanic blacks	99-00	*	< LOD	< LOD	4.62 (3.81-6.00)	7.50 (5.71-7.93)	515
	01-02	*	< LOD	7.04 (3.89-11.6)	41.6 (29.9-55.5)	68.8 (46.0-113)	683
Non-Hispanic whites	99-00	*	< LOD	< LOD	8.57 (7.75-10.4)	13.1 (11.4-15.5)	827
	01-02	*	< LOD	9.42 (6.09-14.7)	38.2 (26.5-47.7)	62.4 (45.5-85.4)	1206

< LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample. See Appendix A for LODs.

* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

3-Hydroxyfluoranthene

Metabolite of Fluoranthene, CAS No. 206-44-0

Data for 3-hydroxyfluoranthene are not available for the current survey period 2001-2002. The table shown here reports data from 1999-2000 only.

Comparing Adjusted Geometric Means

For the 1999-2000 subsample, geometric mean levels of urinary fluorene metabolites in the demographic groups were compared after adjusting for the covariates of race/ethnicity, age, gender, creatinine, and log serum cotinine (data not shown). There were no differences between the demographic groups in adjusted geometric mean levels of urinary 3-hydroxyfluoranthene.

Table 54. 3-Hydroxyfluoranthene

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 1999-2000.

	Survey years	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)				Sample size
			50th	75th	90th	95th	
Total, age 6 and older	99-00	13.4 (9.43-19.0)	17.5 (7.90-25.9)	32.3 (27.4-40.2)	58.6 (49.4-73.0)	98.8 (78.9-147)	2236
Age group							
6-11 years	99-00	12.6 (8.82-17.9)	15.8 (3.90-24.7)	37.6 (24.7-45.1)	65.7 (44.6-146)	138 (66.3-216)	308
12-19 years	99-00	15.0 (9.47-23.9)	20.3 (5.10-31.8)	38.7 (29.6-48.8)	60.6 (47.6-91.4)	98.9 (75.4-162)	675
20 years and older	99-00	13.2 (9.39-18.6)	17.3 (8.20-24.5)	31.1 (26.8-38.5)	58.2 (48.9-74.0)	90.7 (71.7-151)	1253
Gender							
Males	99-00	13.5 (9.55-19.0)	17.4 (8.80-25.1)	32.6 (27.1-42.1)	58.2 (47.6-74.0)	98.8 (64.7-190)	1074
Females	99-00	13.3 (9.26-19.1)	17.5 (6.80-26.1)	31.8 (26.9-39.1)	58.7 (48.9-77.2)	88.4 (68.4-146)	1162
Race/ethnicity							
Mexican Americans	99-00	14.0 (8.96-21.9)	17.1 (6.90-26.8)	30.4 (22.7-44.4)	52.1 (42.9-73.8)	96.6 (60.8-312)	715
Non-Hispanic blacks	99-00	13.9 (8.32-23.2)	17.7 (<LOD-29.3)	38.2 (25.0-57.6)	89.3 (56.8-174)	185 (95.5-291)	527
Non-Hispanic whites	99-00	13.2 (8.64-20.2)	17.3 (6.50-28.1)	32.0 (25.8-41.6)	56.7 (43.6-74.0)	87.3 (64.7-127)	803

< LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample. See Appendix A for LODs.

Table 55. 3-Hydroxyfluoranthene (creatinine corrected)

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 1999-2000.

	Survey years	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)				Sample size
			50th	75th	90th	95th	
Total, age 6 and older	99-00	12.3 (8.39-18.2)	14.7 (7.90-24.9)	36.3 (25.0-47.8)	67.9 (54.4-84.7)	102 (86.0-127)	2236
Age group							
6-11 years	99-00	12.8 (8.49-19.4)	13.7 (5.32-27.2)	44.3 (21.3-66.5)	77.0 (54.7-115)	131 (67.3-254)	308
12-19 years	99-00	10.1 (5.86-17.4)	13.4 (4.90-24.1)	29.1 (19.0-44.3)	54.9 (39.2-84.6)	92.1 (66.6-134)	675
20 years and older	99-00	12.7 (8.76-18.4)	14.8 (8.03-25.7)	36.5 (25.6-46.8)	68.9 (54.4-85.0)	102 (82.9-128)	1253
Gender							
Males	99-00	10.7 (7.16-15.9)	12.1 (6.41-20.7)	32.9 (20.7-45.3)	62.5 (44.3-82.4)	91.3 (72.6-122)	1074
Females	99-00	14.2 (9.70-20.7)	17.5 (9.10-28.0)	39.6 (28.9-49.9)	75.5 (61.3-89.1)	107 (90.5-172)	1162
Race/ethnicity							
Mexican Americans	99-00	12.7 (7.69-21.1)	13.8 (6.76-23.0)	30.7 (20.8-48.2)	64.1 (48.2-97.4)	107 (67.7-312)	715
Non-Hispanic blacks	99-00	9.14 (5.44-15.4)	10.4 (2.98-21.3)	30.2 (19.8-42.6)	72.6 (47.6-116)	133 (84.2-216)	527
Non-Hispanic whites	99-00	13.1 (8.31-20.7)	16.0 (6.45-29.7)	36.9 (25.0-52.1)	68.8 (51.2-86.0)	90.6 (77.0-127)	803

< LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample. See Appendix A for LODs.

2-Hydroxyfluorene, 3-Hydroxyfluorene, and 9-Hydroxyfluorene

Metabolites of Fluorene, CAS No. 86-73-7

Interpreting Levels of Urinary Fluorene Metabolites Reported in the Tables

Urinary levels of 2-hydroxyfluorene, 3-hydroxyfluorene, 9-hydroxyfluorene were measured in a subsample of NHANES 2001-2002 participants aged 6 years and older. Levels of 2-hydroxyfluorene have been shown to be higher in smokers than non-smokers (Toriba et al., 2003).

Comparing Adjusted Geometric Means

Geometric mean levels of urinary fluorene metabolites for the demographic groups were compared after adjusting for the covariates of race/ethnicity, age, gender, creatinine, and log serum cotinine (data not shown). In NHANES 2001-2002, adjusted geometric mean levels of 2- and 3-fluorene were higher for the group aged 6-11

years than either of the groups aged 12-19 years or 20 years and older.

For adjusted geometric mean levels of 9-fluorene in NHANES 2001-2002, the group aged 12-19 years had lower levels than either of the groups aged 6-11 years or 20 years and older.

It is unknown whether these differences associated with age represent differences in exposure, pharmacokinetics, or the relationship of dose per body weight.

Table 56. 2-Hydroxyfluorene

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 1999-2002.

	Survey years	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)				Sample size
			50th	75th	90th	95th	
Total, age 6 and older	99-00	441 (287-678)	422 (237-826)	1350 (895-2290)	3710 (2620-5250)	6450 (4630-9470)	2315
	01-02	318 (277-366)	293 (252-328)	619 (515-779)	1700 (1330-2090)	2820 (2340-3450)	2745
Age group							
6-11 years	99-00	294 (181-477)	262 (157-563)	780 (447-1360)	1800 (1140-2000)	2010 (1810-3260)	306
	01-02	246 (219-277)	262 (212-298)	417 (357-492)	679 (530-926)	979 (773-1180)	387
12-19 years	99-00	469 (301-729)	421 (243-933)	1410 (932-2190)	2810 (2180-4130)	4980 (3540-6610)	694
	01-02	295 (244-357)	267 (237-319)	548 (427-652)	1190 (712-2090)	2190 (1290-3250)	733
20 years and older	99-00	461 (300-709)	456 (251-857)	1510 (973-2620)	4280 (2750-6090)	7270 (4720-10300)	1315
	01-02	333 (287-385)	300 (254-343)	716 (546-893)	1950 (1520-2310)	3140 (2540-3660)	1625
Gender							
Males	99-00	474 (294-765)	468 (223-923)	1450 (875-2460)	3780 (2440-6350)	6920 (4160-12500)	1106
	01-02	377 (324-439)	329 (287-377)	773 (579-1010)	2060 (1480-2690)	3210 (2340-3930)	1346
Females	99-00	412 (276-616)	385 (246-755)	1330 (866-2150)	3600 (2700-4660)	5790 (4350-9470)	1209
	01-02	272 (232-317)	250 (211-296)	512 (425-614)	1270 (1120-1700)	2310 (1990-2920)	1399
Race/ethnicity							
Mexican Americans	99-00	296 (217-404)	268 (164-454)	807 (485-1290)	1870 (1230-2530)	2930 (1900-5400)	750
	01-02	267 (212-337)	270 (200-344)	491 (368-620)	951 (652-1190)	1350 (1080-2130)	662
Non-Hispanic blacks	99-00	646 (337-1240)	680 (258-1520)	2140 (983-4570)	5790 (2680-11800)	10800 (4830-19300)	534
	01-02	459 (401-526)	433 (377-474)	1020 (725-1400)	2200 (1760-3110)	3480 (2520-4770)	692
Non-Hispanic whites	99-00	418 (249-704)	402 (211-860)	1320 (825-2550)	3990 (2590-5150)	6450 (4600-9470)	842
	01-02	310 (259-372)	282 (234-332)	599 (477-817)	1710 (1210-2260)	2920 (2260-3640)	1207

Table 57. 2-Hydroxyfluorene (creatinine corrected)

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 1999-2002.

	Survey years	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)				Sample size
			50th	75th	90th	95th	
Total, age 6 and older	99-00	408 (259-642)	382 (233-713)	1160 (756-1660)	2880 (1960-4350)	5270 (3540-6860)	2315
	01-02	298 (261-340)	240 (209-266)	530 (432-681)	1310 (1100-1490)	1890 (1590-2290)	2745
Age group							
6-11 years	99-00	307 (180-525)	336 (140-724)	787 (520-1200)	1380 (1030-2180)	1740 (1410-2880)	306
	01-02	275 (238-319)	256 (224-289)	387 (319-508)	695 (527-989)	1040 (724-1470)	387
12-19 years	99-00	314 (190-519)	369 (153-619)	785 (543-1300)	1880 (1260-2550)	2570 (2220-3360)	694
	01-02	228 (194-268)	187 (164-220)	358 (278-479)	852 (537-1100)	1170 (885-2150)	733
20 years and older	99-00	443 (283-692)	400 (259-739)	1260 (806-2080)	3480 (2290-5200)	6040 (3990-7970)	1315
	01-02	314 (275-358)	245 (213-277)	597 (491-766)	1430 (1270-1590)	2080 (1700-2530)	1625
Gender							
Males	99-00	376 (225-628)	378 (195-702)	1070 (657-1750)	2440 (1550-4870)	4870 (2630-6870)	1106
	01-02	305 (263-353)	248 (209-290)	563 (449-717)	1330 (1030-1590)	1900 (1460-2460)	1346
Females	99-00	441 (291-667)	393 (250-741)	1260 (841-1680)	3300 (2200-4410)	5490 (3580-7720)	1209
	01-02	291 (255-332)	227 (207-260)	497 (399-649)	1220 (1060-1490)	1890 (1590-2290)	1399
Race/ethnicity							
Mexican Americans	99-00	275 (187-405)	252 (155-443)	597 (394-999)	1350 (960-1720)	2090 (1410-3110)	750
	01-02	250 (206-303)	221 (176-279)	375 (306-501)	711 (517-1040)	1350 (787-2060)	662
Non-Hispanic blacks	99-00	425 (219-823)	541 (174-1070)	1190 (679-2650)	3090 (1500-7100)	6040 (3080-8500)	534
	01-02	323 (281-373)	273 (220-334)	660 (496-856)	1290 (1050-1700)	1880 (1590-2460)	692
Non-Hispanic whites	99-00	414 (241-711)	387 (215-762)	1240 (756-1910)	3110 (2050-4880)	5620 (3670-7370)	842
	01-02	306 (260-360)	243 (208-273)	546 (435-741)	1400 (1140-1590)	2080 (1530-2620)	1207

Figure 14. 2-Hydroxyfluorene (creatinine corrected)

Selected percentiles with 95% confidence intervals of urine concentrations (in ng/g of creatinine) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 1999-2002.

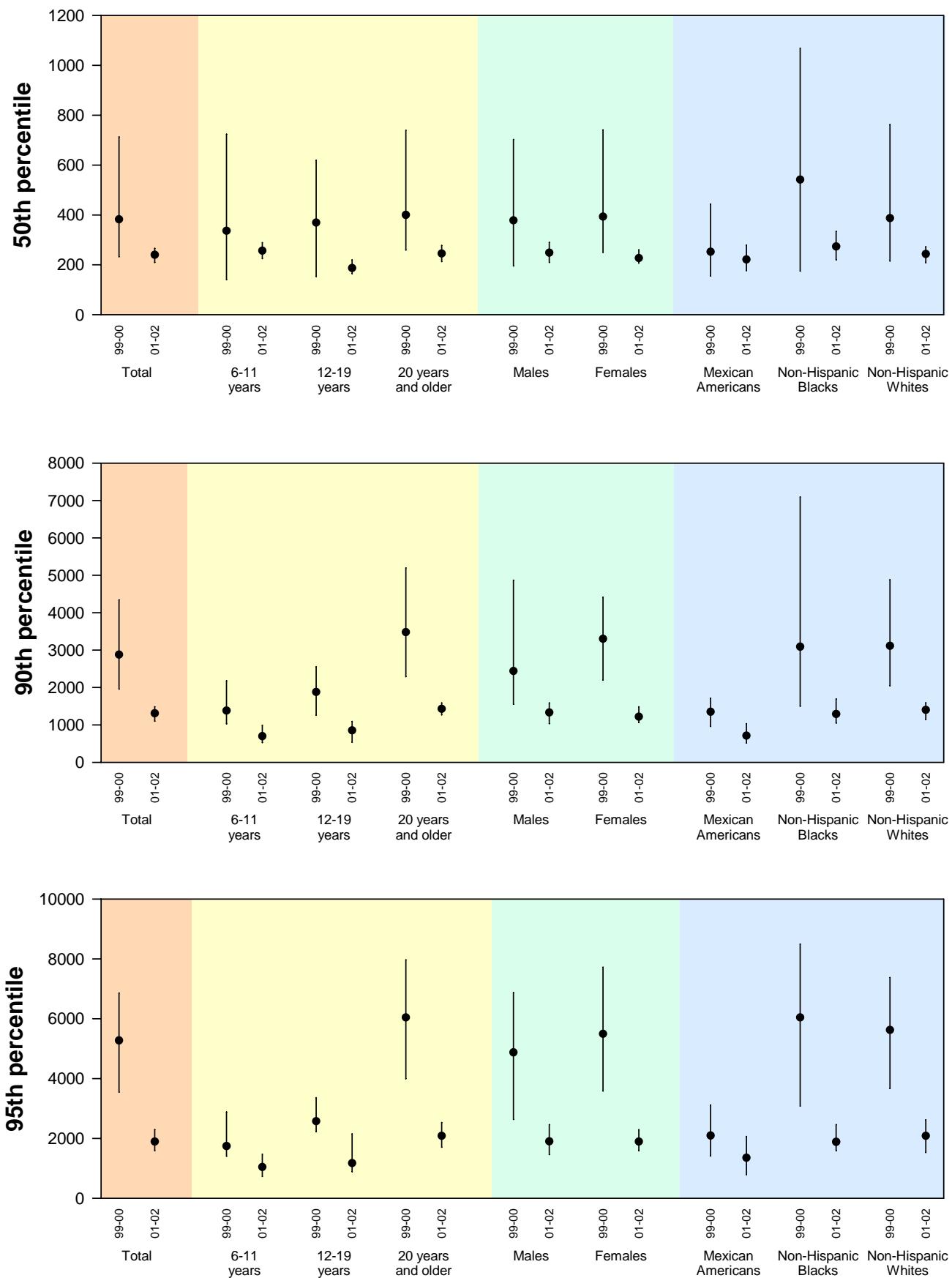


Table 58. 3-Hydroxyfluorene

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 1999-2002.

	Survey years	Geometric mean		Selected percentiles (95% confidence interval)				Sample size
		(95% conf. interval)		50th	75th	90th	95th	
Total, age 6 and older	99-00	170 (114-254)		151 (86.3-280)	572 (341-956)	1840 (1260-2530)	3390 (2290-4680)	2312
	01-02	134 (115-155)		111 (96.0-125)	253 (207-349)	959 (666-1300)	1620 (1390-1900)	2745
Age group								
6-11 years	99-00	105 (70.3-157)		92.8 (57.2-166)	247 (137-439)	615 (328-851)	851 (647-1290)	306
	01-02	106 (94.8-119)		106 (90.0-124)	174 (145-200)	287 (235-358)	377 (306-455)	387
12-19 years	99-00	192 (126-293)		198 (119-295)	621 (358-903)	1330 (978-1910)	2110 (1550-2400)	692
	01-02	129 (103-161)		113 (97.0-137)	221 (177-266)	542 (325-1070)	1210 (680-2130)	733
20 years and older	99-00	178 (117-269)		156 (89.1-306)	639 (375-1160)	2080 (1450-3350)	4060 (2600-5020)	1314
	01-02	138 (119-161)		110 (94.0-128)	311 (228-429)	1130 (823-1400)	1840 (1470-2080)	1625
Gender								
Males	99-00	189 (119-299)		167 (85.4-319)	689 (341-1230)	2060 (1320-3160)	3520 (2090-6060)	1105
	01-02	163 (137-194)		134 (114-154)	352 (242-481)	1100 (721-1500)	1810 (1390-2190)	1346
Females	99-00	154 (106-224)		141 (85.2-250)	478 (333-742)	1710 (986-2490)	3010 (1900-4610)	1207
	01-02	111 (95.0-130)		93.0 (83.0-108)	203 (167-248)	796 (498-1040)	1390 (1230-1660)	1399
Race/ethnicity								
Mexican Americans	99-00	105 (75.6-145)		96.7 (53.8-167)	313 (203-432)	862 (493-1370)	1490 (941-1650)	748
	01-02	108 (87.1-134)		98.0 (80.0-118)	190 (144-255)	476 (302-641)	668 (476-1140)	662
Non-Hispanic blacks	99-00	266 (145-489)		257 (116-572)	954 (441-1750)	2800 (1320-5800)	5290 (2390-8600)	534
	01-02	203 (169-244)		161 (135-188)	444 (308-830)	1420 (1130-1780)	2350 (1520-3000)	692
Non-Hispanic whites	99-00	161 (99.9-259)		137 (72.9-298)	552 (318-964)	1910 (1160-2720)	3590 (2290-4730)	842
	01-02	130 (108-157)		108 (93.0-127)	246 (202-352)	948 (621-1320)	1610 (1320-1990)	1207

Table 59. 3-Hydroxyfluorene (creatinine corrected)

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 1999-2002.

	Survey years	Geometric mean		Selected percentiles (95% confidence interval)				Sample size
		(95% conf. interval)		50th	75th	90th	95th	
Total, age 6 and older	99-00	157 (102-241)		135 (79.9-234)	482 (306-766)	1510 (918-2540)	2710 (1780-4060)	2312
	01-02	125 (108-144)		94.4 (83.3-106)	219 (174-303)	754 (622-873)	1060 (909-1290)	2745
Age group								
6-11 years	99-00	110 (69.8-173)		111 (62.4-204)	268 (175-418)	504 (324-832)	832 (480-1540)	306
	01-02	119 (103-137)		110 (96.7-121)	153 (135-197)	264 (206-377)	382 (254-631)	387
12-19 years	99-00	129 (79.4-209)		140 (68.7-253)	374 (228-496)	799 (536-1120)	1130 (917-1390)	692
	01-02	99.3 (81.6-121)		81.5 (74.2-92.6)	144 (109-197)	390 (214-700)	700 (372-1380)	733
20 years and older	99-00	170 (111-262)		138 (83.9-244)	613 (329-978)	1820 (1130-2730)	3020 (2140-4290)	1314
	01-02	131 (113-151)		94.0 (81.0-108)	279 (195-367)	853 (727-923)	1210 (1010-1350)	1625
Gender								
Males	99-00	150 (90.9-246)		128 (72.9-253)	496 (270-807)	1390 (777-2710)	2710 (1440-4170)	1105
	01-02	132 (111-156)		99.4 (87.3-116)	260 (194-361)	745 (560-914)	1130 (862-1380)	1346
Females	99-00	164 (111-243)		138 (86.6-228)	477 (311-792)	1650 (1050-2400)	2860 (2000-3790)	1207
	01-02	119 (104-136)		88.9 (78.6-103)	179 (156-227)	777 (604-888)	1030 (923-1270)	1399
Race/ethnicity								
Mexican Americans	99-00	97.5 (65.6-145)		89.2 (52.4-147)	220 (146-338)	665 (380-854)	987 (709-1600)	748
	01-02	101 (84.2-121)		84.0 (74.8-97.2)	158 (124-214)	364 (227-598)	598 (357-1230)	662
Non-Hispanic blacks	99-00	175 (94.1-325)		176 (74.3-364)	550 (313-1060)	1590 (828-2830)	2710 (1590-3950)	534
	01-02	143 (118-173)		110 (90.7-133)	316 (186-525)	849 (622-1230)	1240 (882-1430)	692
Non-Hispanic whites	99-00	159 (96.6-262)		138 (73.4-260)	505 (314-832)	1650 (967-2700)	2920 (1830-4210)	842
	01-02	128 (108-152)		94.7 (83.4-109)	223 (171-323)	816 (642-914)	1150 (910-1410)	1207

Figure 15. 3-Hydroxyfluorene (creatinine corrected)

Selected percentiles with 95% confidence intervals of urine concentrations (in ng/g of creatinine) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 1999-2002.

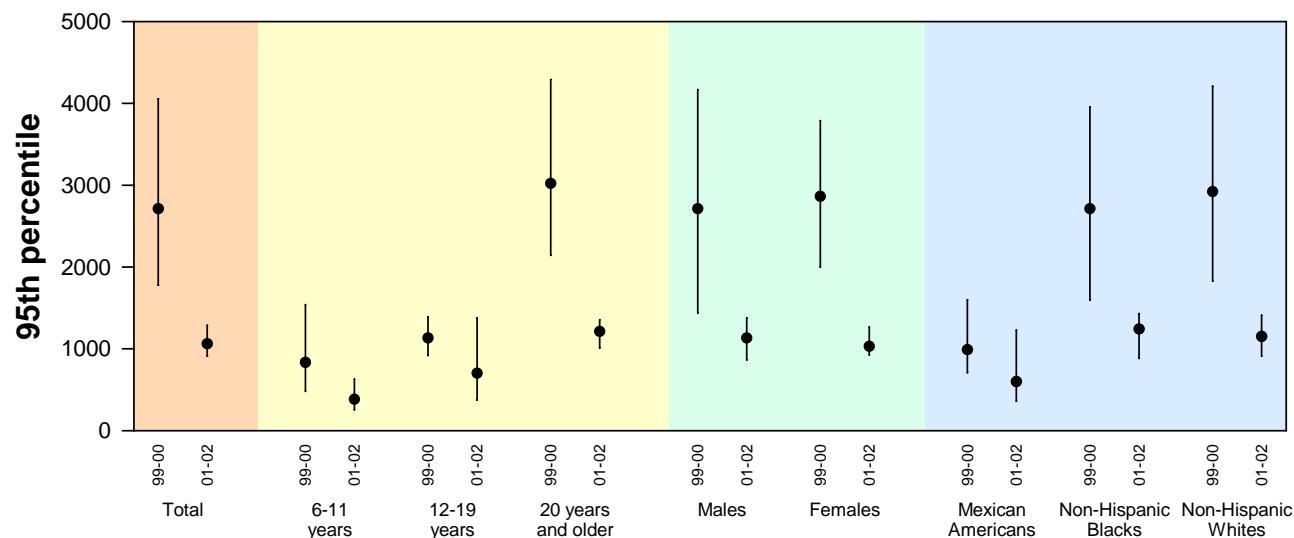
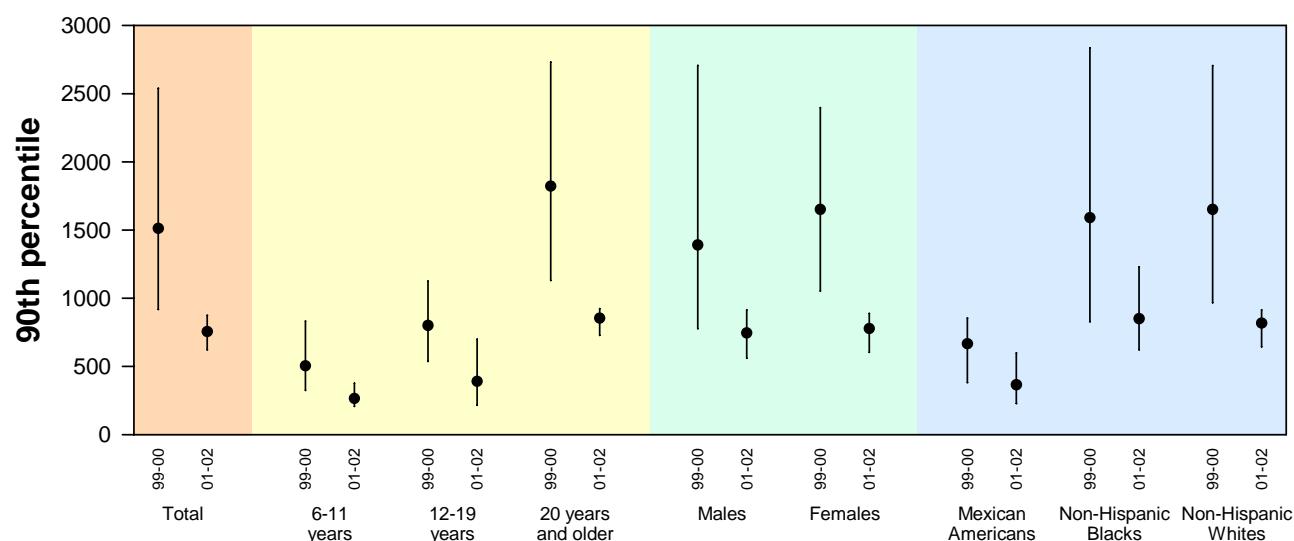
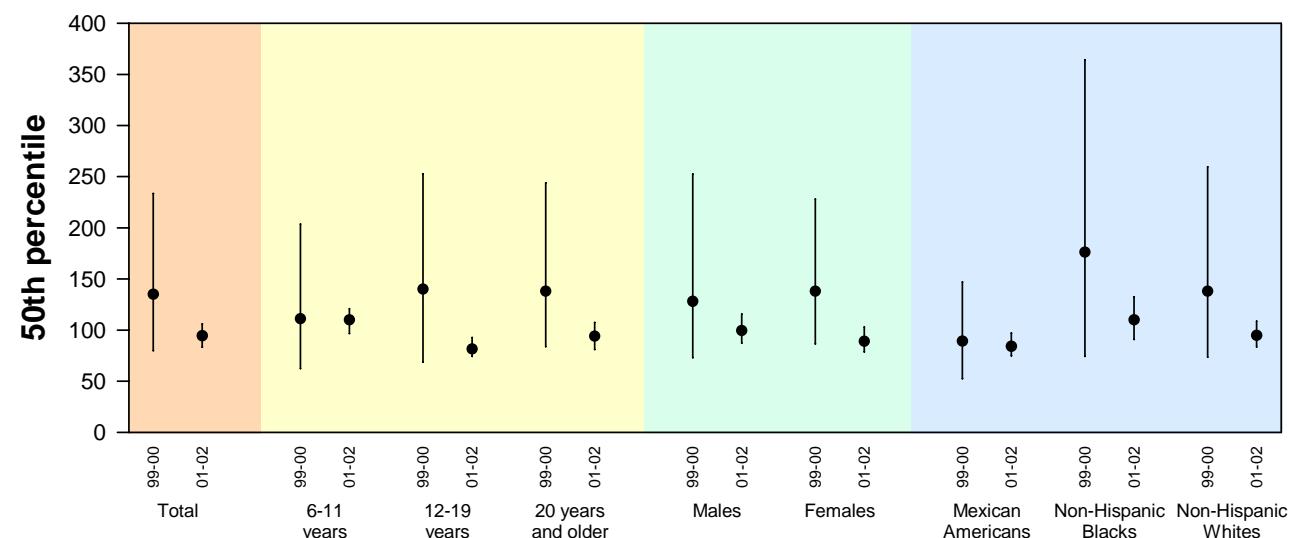


Table 60. 9-Hydroxyfluorene

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 2001-2002.

	Survey years	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)				Sample size
			50th	75th	90th	95th	
Total, age 6 and older	01-02	219 (191-251)	219 (186-258)	429 (363-510)	779 (690-897)	1090 (950-1300)	2745
Age group							
6-11 years	01-02	169 (142-201)	168 (144-202)	295 (255-369)	487 (415-683)	720 (546-994)	387
12-19 years	01-02	197 (161-242)	200 (153-266)	370 (319-445)	666 (527-784)	883 (679-1270)	733
20 years and older	01-02	230 (199-265)	231 (201-270)	452 (376-568)	839 (726-965)	1150 (995-1360)	1625
Gender							
Males	01-02	251 (217-292)	249 (207-296)	475 (396-578)	858 (698-1080)	1240 (990-1520)	1346
Females	01-02	192 (164-225)	194 (164-238)	387 (328-462)	701 (617-881)	1020 (913-1100)	1399
Race/ethnicity							
Mexican Americans	01-02	199 (147-269)	202 (155-273)	347 (277-506)	701 (451-1080)	1080 (603-1690)	662
Non-Hispanic blacks	01-02	327 (287-373)	324 (289-348)	609 (538-708)	1060 (884-1430)	1570 (1130-2350)	692
Non-Hispanic whites	01-02	213 (182-250)	214 (176-260)	414 (347-508)	772 (676-868)	1060 (884-1300)	1207

Table 61. 9-Hydroxyfluorene (creatinine corrected)

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 2001-2002.

	Survey years	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)				Sample size
			50th	75th	90th	95th	
Total, age 6 and older	01-02	205 (183-229)	206 (181-232)	353 (312-393)	585 (507-697)	852 (736-1120)	2745
Age group							
6-11 years	01-02	189 (156-228)	197 (162-238)	330 (285-372)	542 (426-660)	740 (568-1010)	387
12-19 years	01-02	152 (130-179)	145 (120-183)	256 (212-313)	432 (348-584)	642 (497-970)	733
20 years and older	01-02	217 (194-243)	219 (189-245)	373 (331-412)	608 (525-736)	933 (747-1250)	1625
Gender							
Males	01-02	203 (180-230)	198 (173-227)	348 (300-408)	607 (526-722)	843 (745-1070)	1346
Females	01-02	206 (182-234)	213 (183-245)	361 (306-395)	541 (488-697)	894 (702-1160)	1399
Race/ethnicity							
Mexican Americans	01-02	186 (143-243)	182 (142-250)	302 (233-416)	515 (375-724)	724 (515-1380)	662
Non-Hispanic blacks	01-02	231 (201-265)	224 (199-240)	359 (324-388)	605 (453-929)	1190 (674-1680)	692
Non-Hispanic whites	01-02	211 (186-239)	211 (178-245)	367 (324-411)	605 (521-719)	896 (747-1160)	1207

1-Hydroxyphenanthrene, 2-Hydroxyphenanthrene, 3-Hydroxyphenanthrene, 4-Hydroxyphenanthrene, and 9-Hydroxyphenanthrene

Metabolites of Phenanthrene, CAS No. 85-01-8

Interpreting Levels of Urinary Phenanthrene Metabolites Reported in the Tables

Urinary levels of 1-hydroxyphenanthrene, 2-hydroxyphenanthrene, 3-hydroxyphenanthrene, 4-hydroxyphenanthrene, and 9-hydroxyphenanthrene were measured in a subsample of NHANES 2001-2002 participants aged 6 years and older. Residents of homes with PAH contaminated parquet flooring had higher mean urinary 1-, 2-, 3- and 4-hydroxy-phenanthrene levels than were found in this NHANES 1999-2002 subsample (Heudorf and Angerer, 2001a). Workers manufacturing fireproof stone had urinary levels of 1-, 2-, 3- and 4-hydroxy-phenanthrene levels that were about ten times higher than the levels that were found in this NHANES 1999-2002 subsample (Gundel et al., 2000).

Tobacco smoking increased levels of 2-, 3- and 4-hydroxyphenanthrene levels (Heudorf and Angerer, 2001b).

Comparing Adjusted Geometric Means

Geometric means levels of urinary phenanthrene metabolites for the demographic groups were compared after adjusting for the covariates of race/ethnicity, age, gender, log serum cotinine, and urinary creatinine (data not shown). In NHANES 2001-2002, adjusted geometric mean levels of urinary 1-hydroxyphenanthrene were higher in females than males, higher in non-Hispanic whites than non-Hispanic blacks, and higher in the group aged 6-11 years than either of the groups aged 12-19 years or 20 years and older.

Table 62. 1-Hydroxyphenanthrene

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 1999-2002.

	Survey years	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)				Sample size
			50th	75th	90th	95th	
Total, age 6 and older	99-00	154 (115-206)	160 (105-236)	367 (280-483)	698 (609-836)	1070 (851-1390)	2246
	01-02	140 (125-158)	140 (128-152)	266 (229-312)	476 (426-539)	684 (581-763)	2741
Age group							
6-11 years	99-00	121 (85.4-172)	102 (74.2-204)	257 (184-389)	513 (360-666)	666 (535-1080)	294
	01-02	119 (104-137)	121 (98.0-142)	228 (182-249)	357 (265-501)	493 (367-661)	387
12-19 years	99-00	167 (128-218)	175 (137-229)	353 (266-443)	688 (580-865)	1080 (721-1560)	680
	01-02	133 (110-162)	130 (109-152)	238 (198-303)	429 (376-546)	579 (439-820)	733
20 years and older	99-00	157 (116-212)	163 (105-247)	400 (295-523)	739 (623-899)	1100 (859-1530)	1272
	01-02	145 (127-164)	145 (132-163)	273 (237-326)	498 (440-565)	712 (582-789)	1621
Gender							
Males	99-00	153 (112-209)	147 (99.8-236)	351 (262-498)	680 (588-836)	1020 (735-1590)	1072
	01-02	150 (133-169)	145 (132-164)	284 (235-348)	499 (424-593)	713 (575-845)	1344
Females	99-00	156 (118-205)	172 (119-236)	372 (290-480)	753 (610-946)	1100 (855-1530)	1174
	01-02	132 (115-152)	136 (120-151)	254 (221-297)	462 (390-520)	654 (538-769)	1397
Race/ethnicity							
Mexican Americans	99-00	113 (94.9-134)	113 (98.9-137)	230 (180-314)	447 (328-557)	618 (459-745)	727
	01-02	117 (90.8-152)	115 (88.0-147)	214 (157-294)	364 (254-583)	514 (342-847)	664
Non-Hispanic blacks	99-00	162 (100-262)	170 (82.7-303)	441 (252-680)	821 (574-1300)	1210 (790-2290)	516
	01-02	150 (127-179)	145 (126-170)	287 (243-327)	493 (423-629)	713 (568-975)	690
Non-Hispanic whites	99-00	154 (109-218)	156 (102-248)	378 (267-533)	704 (604-891)	1060 (867-1450)	815
	01-02	144 (125-166)	143 (130-160)	276 (241-330)	489 (436-552)	649 (550-793)	1204

For adjusted geometric mean levels of urinary 2-hydroxyphenanthrene in the NHANES 2001-2002, there were no demographic differences observed.

For adjusted geometric mean levels of urinary 3-hydroxyphenanthrene, in NHANES 2001-2002, higher levels were observed in the group aged 6-11 years than either of the groups age 12-19 years or 20 years and older. Non-Hispanic whites had higher levels than Mexican Americans.

For adjusted geometric mean levels of urinary 4-hydroxyphenanthrene, in NHANES 2001-2002, no demographic group differences were observed.

For adjusted geometric mean levels of urinary 9-hydroxyphenanthrene, in NHANES 2001-2002, non-Hispanic whites had higher levels than either non-Hispanic blacks or Mexican Americans. Also, Mexican Americans had higher levels than non-Hispanic blacks.

It is unknown whether these differences associated with age, gender or race/ethnicity represent differences in exposure, pharmacokinetics, or the relationship of dose per body weight.

Table 63. 1-Hydroxyphenanthrene (creatinine corrected)

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 1999-2002.

	Survey years	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)				Sample size
			50th	75th	90th	95th	
Total, age 6 and older	99-00	142 (103-195)	143 (102-204)	299 (240-379)	571 (450-693)	907 (652-1270)	2246
	01-02	132 (118-147)	125 (113-141)	210 (191-231)	344 (310-385)	464 (404-539)	2741
Age group							
6-11 years	99-00	127 (86.4-187)	135 (85.8-206)	265 (185-372)	457 (372-577)	622 (503-913)	294
	01-02	133 (116-153)	125 (110-147)	188 (165-225)	344 (245-437)	452 (364-598)	387
12-19 years	99-00	112 (79.9-156)	121 (93.5-154)	207 (164-283)	406 (293-632)	661 (421-972)	680
	01-02	103 (87.9-121)	97.2 (81.4-117)	158 (131-192)	237 (198-322)	354 (235-531)	733
20 years and older	99-00	150 (109-207)	150 (104-220)	321 (254-397)	603 (462-828)	973 (671-1530)	1272
	01-02	137 (122-153)	131 (117-145)	223 (200-243)	351 (319-395)	476 (421-541)	1621
Gender							
Males	99-00	120 (85.0-170)	124 (81.4-187)	260 (195-328)	479 (362-641)	692 (497-1090)	1072
	01-02	122 (108-137)	116 (104-131)	194 (173-218)	314 (262-395)	450 (348-642)	1344
Females	99-00	166 (122-225)	166 (120-219)	351 (276-418)	631 (474-969)	1120 (643-2180)	1174
	01-02	142 (125-160)	136 (118-156)	226 (199-256)	353 (323-399)	473 (421-541)	1397
Race/ethnicity							
Mexican Americans	99-00	104 (81.4-133)	104 (78.8-141)	192 (154-234)	327 (241-456)	474 (372-672)	727
	01-02	110 (88.6-136)	101 (85.5-131)	162 (138-203)	275 (187-452)	396 (268-755)	664
Non-Hispanic blacks	99-00	107 (65.5-174)	109 (56.6-209)	269 (173-395)	548 (358-847)	887 (534-1410)	516
	01-02	106 (88.7-127)	102 (92.4-111)	172 (141-203)	272 (224-356)	384 (308-598)	690
Non-Hispanic whites	99-00	151 (104-220)	153 (99.9-236)	323 (249-395)	580 (468-820)	1010 (643-1510)	815
	01-02	142 (126-161)	137 (119-153)	226 (206-247)	363 (321-406)	476 (411-552)	1204

Figure 16. 1-Hydroxyphenanthrene (creatinine corrected)

Selected percentiles with 95% confidence intervals of urine concentrations (in ng/g of creatinine) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 1999-2002.

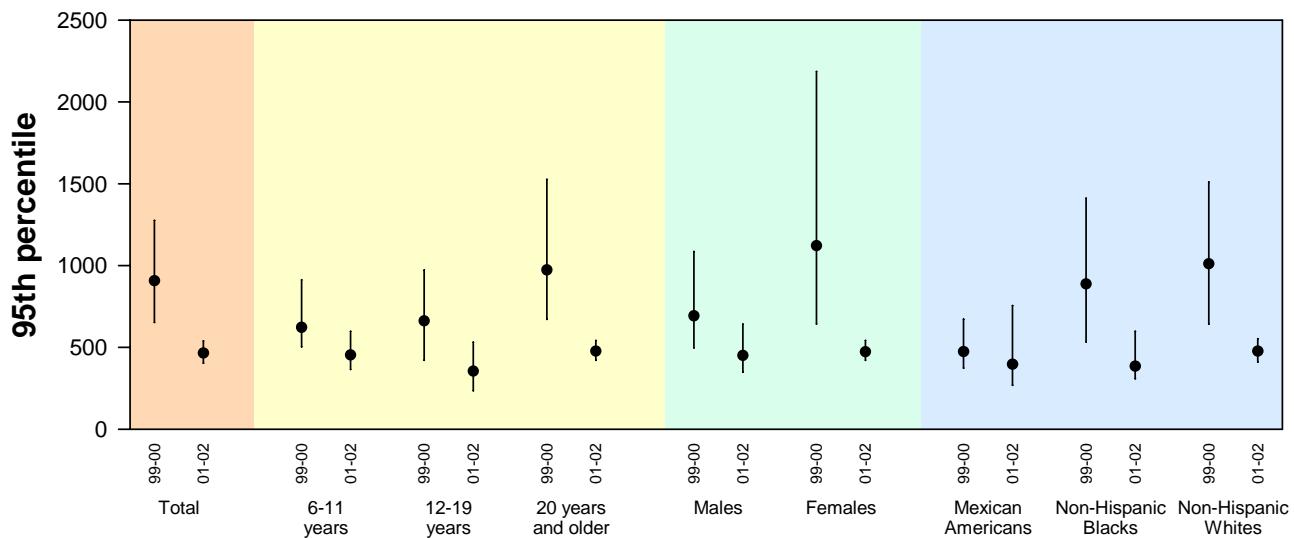
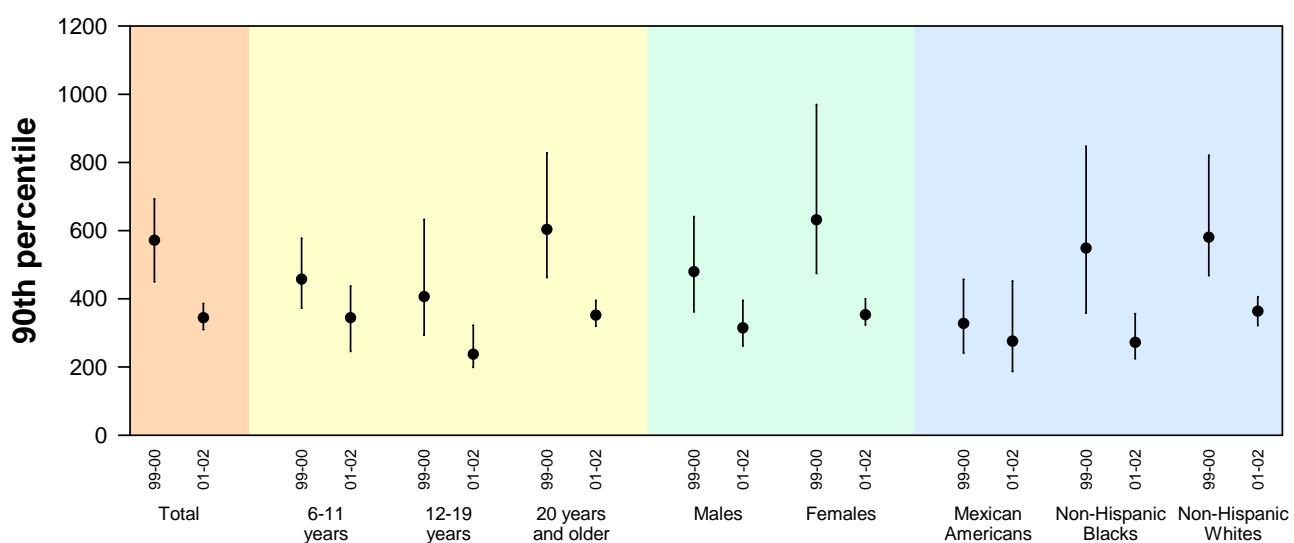
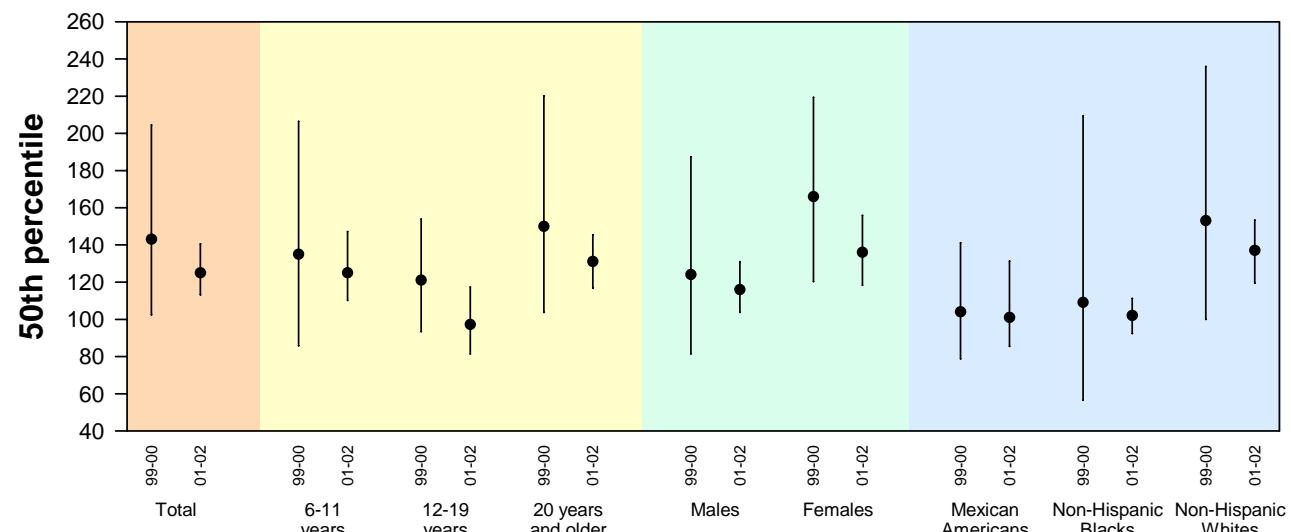


Table 64. 2-Hydroxyphenanthrene

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 1999-2002.

	Survey years	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)				Sample size
			50th	75th	90th	95th	
Total, age 6 and older	99-00	98.3 (76.6-126)	107 (79.7-141)	240 (194-335)	545 (448-689)	828 (714-937)	2179
	01-02	54.0 (46.0-63.5)	57.0 (49.0-68.0)	117 (102-140)	240 (200-271)	332 (299-377)	2742
Age group							
6-11 years	99-00	79.6 (57.3-111)	74.1 (45.8-113)	189 (113-289)	401 (283-585)	698 (383-1140)	291
	01-02	40.5 (34.3-47.7)	45.0 (37.0-57.0)	87.0 (71.0-101)	170 (133-207)	257 (195-320)	387
12-19 years	99-00	109 (90.0-132)	112 (92.6-139)	233 (183-296)	529 (427-615)	767 (570-1250)	650
	01-02	49.5 (37.3-65.7)	51.0 (41.0-68.0)	107 (90.0-122)	210 (145-270)	281 (214-524)	733
20 years and older	99-00	99.3 (76.4-129)	108 (81.2-148)	253 (203-345)	571 (454-721)	864 (721-945)	1238
	01-02	56.8 (48.1-66.9)	60.0 (51.0-73.0)	126 (104-152)	249 (207-292)	342 (308-398)	1622
Gender							
Males	99-00	107 (81.9-140)	109 (82.2-158)	263 (199-382)	592 (448-778)	928 (702-1340)	1048
	01-02	62.1 (53.3-72.5)	67.0 (58.0-80.0)	135 (109-161)	274 (245-303)	359 (329-414)	1345
Females	99-00	90.6 (70.7-116)	105 (72.7-132)	226 (183-307)	514 (402-632)	797 (579-915)	1131
	01-02	47.4 (39.1-57.5)	50.0 (40.0-59.0)	105 (88.0-128)	200 (171-240)	292 (236-357)	1397
Race/ethnicity							
Mexican Americans	99-00	86.0 (69.6-106)	92.3 (68.9-124)	217 (163-285)	432 (325-482)	583 (433-913)	698
	01-02	46.8 (32.7-66.8)	51.0 (35.0-72.0)	95.0 (72.0-137)	191 (122-332)	303 (187-652)	665
Non-Hispanic blacks	99-00	131 (84.6-202)	141 (69.6-250)	370 (214-562)	698 (476-1080)	1080 (782-2310)	509
	01-02	71.1 (58.0-87.1)	74.0 (66.0-90.0)	152 (123-182)	260 (217-311)	374 (284-560)	690
Non-Hispanic whites	99-00	91.7 (67.2-125)	103 (70.6-139)	231 (177-339)	514 (409-712)	810 (680-906)	792
	01-02	53.1 (43.6-64.6)	57.0 (47.0-66.0)	116 (98.0-144)	242 (199-286)	333 (303-385)	1204

Table 65. 2-Hydroxyphenanthrene (creatinine corrected)

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 1999-2002.

	Survey years	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)				Sample size
			50th	75th	90th	95th	
Total, age 6 and older	99-00	90.3 (69.3-118)	89.8 (67.8-119)	188 (147-255)	368 (310-439)	521 (426-748)	2179
	01-02	50.6 (43.3-59.2)	52.5 (46.4-59.6)	91.4 (78.7-108)	164 (138-200)	231 (206-275)	2742
Age group							
6-11 years	99-00	83.8 (59.6-118)	74.4 (58.8-98.3)	173 (98.3-289)	350 (275-402)	413 (350-702)	291
	01-02	45.3 (38.8-52.8)	49.7 (39.8-57.8)	85.9 (69.6-100)	144 (105-217)	234 (138-397)	387
12-19 years	99-00	74.0 (57.7-94.8)	75.0 (58.8-91.4)	133 (105-196)	295 (214-377)	441 (319-611)	650
	01-02	38.4 (29.6-49.7)	38.5 (30.6-48.7)	64.9 (52.4-84.0)	116 (86.7-167)	173 (128-305)	733
20 years and older	99-00	94.3 (71.8-124)	94.9 (68.0-131)	197 (157-263)	392 (310-486)	573 (466-810)	1238
	01-02	53.7 (46.2-62.4)	55.6 (49.4-62.0)	94.2 (84.1-112)	173 (145-201)	241 (209-287)	1622
Gender							
Males	99-00	85.2 (64.7-112)	80.6 (63.0-110)	175 (135-231)	375 (293-438)	544 (413-810)	1048
	01-02	50.4 (43.3-58.5)	52.5 (47.2-59.2)	91.4 (78.6-103)	176 (140-208)	245 (206-349)	1345
Females	99-00	95.5 (72.5-126)	97.1 (71.5-133)	207 (163-262)	367 (310-448)	536 (393-816)	1131
	01-02	50.9 (42.7-60.7)	52.4 (45.5-61.0)	91.6 (75.0-115)	158 (133-183)	213 (200-245)	1397
Race/ethnicity							
Mexican Americans	99-00	78.8 (62.0-100)	77.3 (61.9-101)	155 (113-202)	310 (222-370)	382 (303-618)	698
	01-02	43.7 (31.9-59.8)	43.9 (34.3-58.8)	80.5 (59.8-115)	146 (103-245)	242 (144-394)	665
Non-Hispanic blacks	99-00	86.9 (55.8-135)	93.3 (48.8-159)	207 (131-318)	408 (291-664)	664 (470-993)	509
	01-02	50.2 (40.5-62.2)	49.6 (44.3-56.0)	87.6 (72.5-103)	173 (127-224)	251 (178-459)	690
Non-Hispanic whites	99-00	89.4 (64.9-123)	87.8 (65.8-122)	188 (141-261)	366 (300-439)	536 (411-810)	792
	01-02	52.5 (43.8-62.9)	54.7 (47.7-61.9)	92.5 (80.5-113)	170 (140-204)	231 (202-293)	1204

Figure 17. 2-Hydroxyphenanthrene (creatinine corrected)

Selected percentiles with 95% confidence intervals of urine concentrations (in ng/g of creatinine) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 1999-2002.

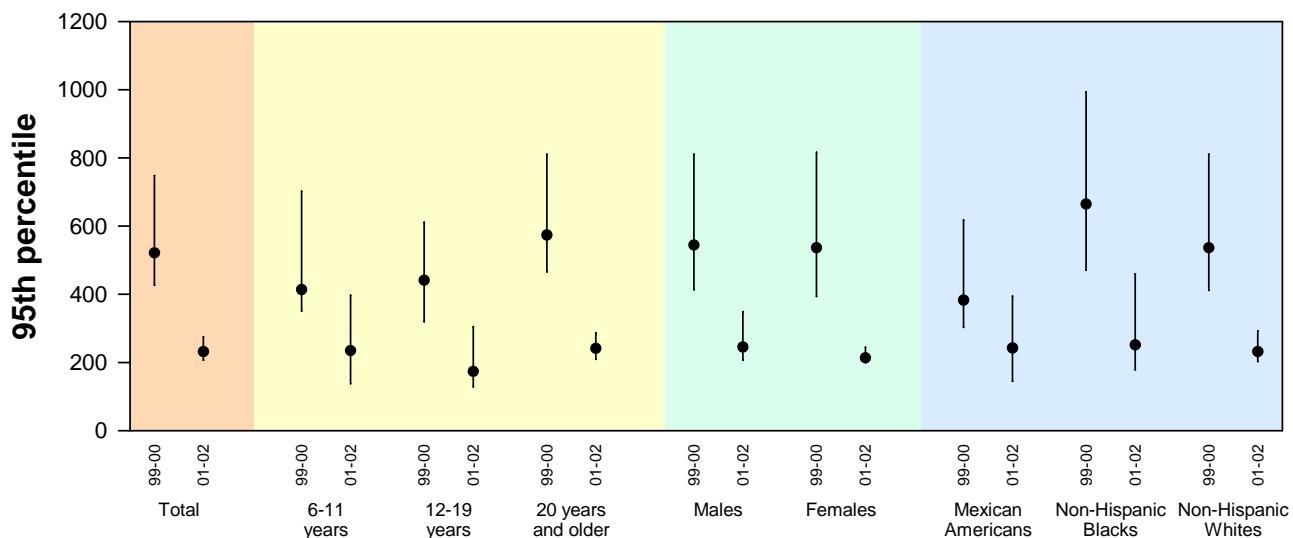
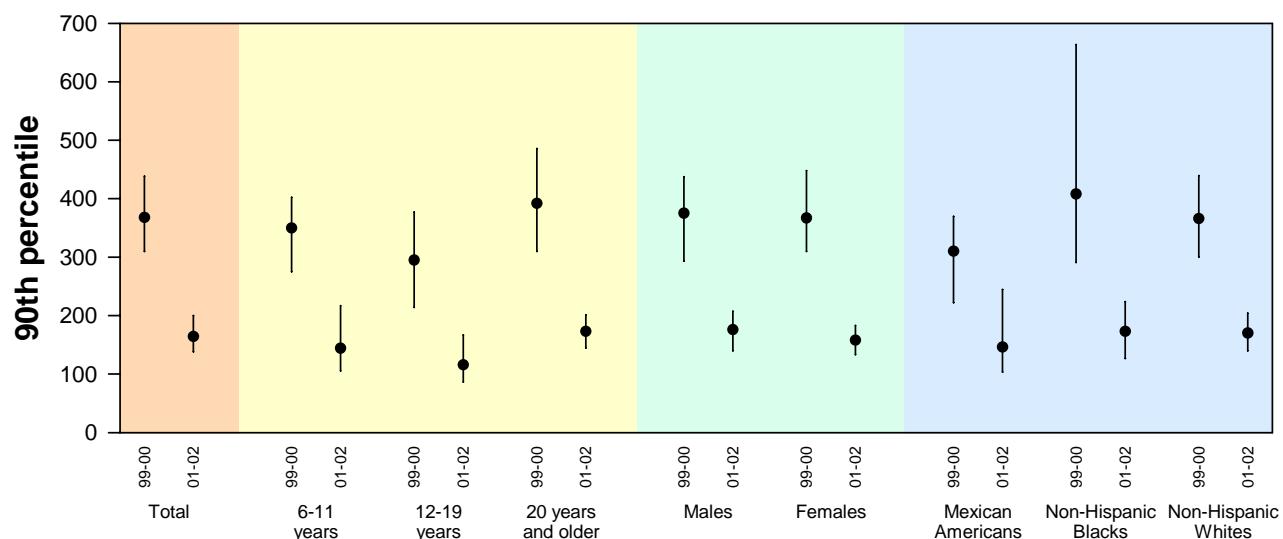
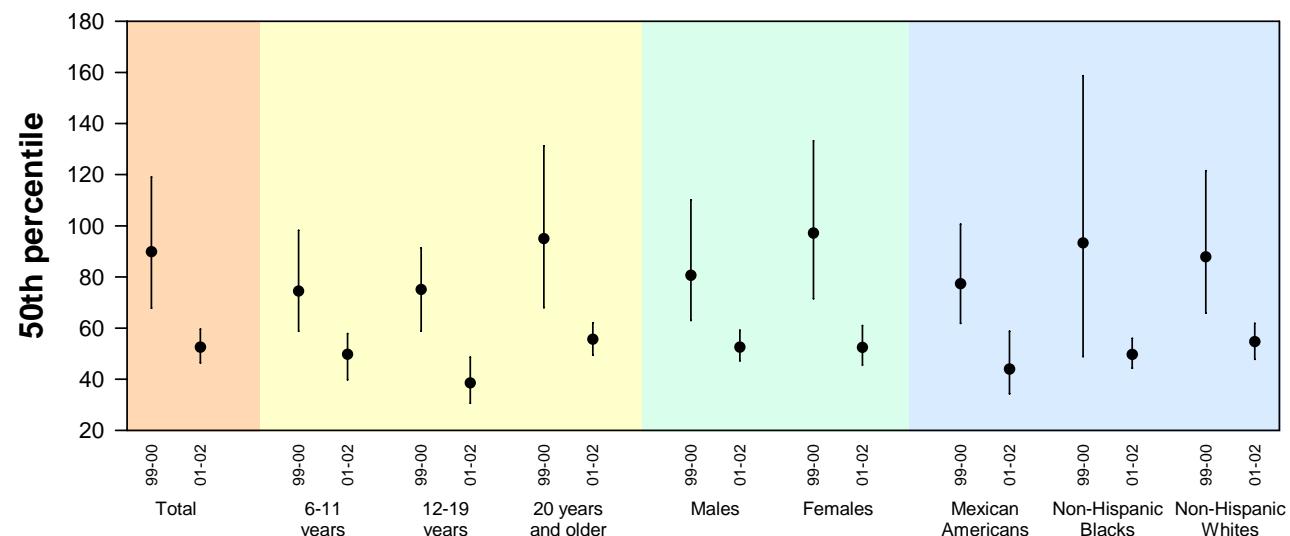


Table 66. 3-Hydroxyphenanthrene

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 1999-2002.

	Survey years	Geometric mean		Selected percentiles (95% confidence interval)				Sample size
		(95% conf. interval)		50th	75th	90th	95th	
Total, age 6 and older	99-00	127 (106-152)		138 (113-165)	256 (225-297)	464 (399-547)	657 (594-721)	2299
	01-02	105 (92.5-118)		105 (90.0-118)	200 (178-225)	400 (336-480)	649 (542-747)	2741
Age group								
6-11 years	99-00	136 (102-181)		140 (102-197)	247 (185-334)	383 (280-632)	622 (336-794)	302
	01-02	105 (91.1-122)		108 (81.0-136)	193 (160-231)	298 (245-346)	412 (319-545)	387
12-19 years	99-00	147 (126-173)		163 (137-196)	281 (240-322)	417 (363-536)	611 (457-725)	700
	01-02	104 (87.3-125)		106 (90.0-122)	201 (165-231)	329 (255-444)	447 (331-631)	733
20 years and older	99-00	122 (102-146)		133 (108-155)	254 (223-295)	477 (410-554)	671 (594-760)	1297
	01-02	105 (91.7-119)		105 (89.0-118)	200 (178-228)	433 (366-515)	683 (597-806)	1621
Gender								
Males	99-00	141 (114-174)		149 (119-185)	287 (225-357)	495 (409-626)	658 (552-802)	1100
	01-02	122 (107-138)		117 (105-131)	224 (187-277)	474 (372-597)	734 (597-1010)	1344
Females	99-00	114 (96.2-135)		130 (102-152)	242 (215-270)	399 (346-506)	624 (554-718)	1199
	01-02	90.8 (77.7-106)		92.0 (80.0-106)	184 (155-207)	328 (287-386)	518 (429-649)	1397
Race/ethnicity								
Mexican Americans	99-00	113 (103-123)		120 (99.7-139)	231 (193-244)	353 (296-438)	495 (369-635)	763
	01-02	83.5 (64.1-109)		83.0 (63.0-111)	144 (116-193)	259 (189-421)	454 (253-1140)	664
Non-Hispanic blacks	99-00	174 (124-245)		182 (116-292)	390 (289-470)	671 (477-1060)	1110 (775-2750)	522
	01-02	145 (122-172)		135 (120-163)	281 (228-346)	507 (407-684)	957 (609-1410)	690
Non-Hispanic whites	99-00	120 (95.3-151)		135 (107-167)	248 (217-292)	448 (356-554)	632 (515-721)	821
	01-02	104 (90.8-120)		105 (91.0-119)	199 (177-224)	401 (331-495)	649 (518-747)	1204

Table 67. 3-Hydroxyphenanthrene (creatinine corrected)

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 1999-2002.

	Survey years	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)				Sample size
			50th	75th	90th	95th	
Total, age 6 and older	99-00	116 (94.5-143)	121 (101-144)	198 (171-235)	365 (312-400)	480 (402-574)	2299
	01-02	98.0 (87.4-110)	86.5 (78.8-97.1)	158 (142-174)	299 (252-342)	428 (360-621)	2741
Age group							
6-11 years	99-00	143 (106-192)	155 (114-197)	226 (183-331)	416 (326-436)	440 (418-499)	302
	01-02	118 (103-135)	114 (94.9-131)	173 (150-201)	289 (238-368)	408 (308-544)	387
12-19 years	99-00	99.3 (78.5-126)	112 (92.9-124)	173 (134-213)	261 (213-317)	317 (273-402)	700
	01-02	81.1 (70.1-93.8)	78.0 (66.7-89.4)	116 (96.5-144)	205 (153-275)	275 (198-511)	733
20 years and older	99-00	116 (94.9-143)	118 (99.2-140)	201 (167-241)	374 (316-444)	502 (410-675)	1297
	01-02	98.9 (88.3-111)	85.2 (78.3-96.6)	164 (147-183)	320 (273-356)	488 (379-774)	1621
Gender							
Males	99-00	111 (86.9-143)	122 (97.6-143)	189 (157-240)	355 (240-466)	470 (387-633)	1100
	01-02	98.6 (87.7-111)	87.1 (79.5-98.2)	159 (138-188)	310 (245-368)	505 (356-761)	1344
Females	99-00	121 (99.8-147)	120 (101-150)	214 (168-265)	369 (326-401)	487 (400-675)	1199
	01-02	97.5 (84.9-112)	86.3 (76.7-100)	157 (139-178)	292 (245-333)	410 (352-583)	1397
Race/ethnicity							
Mexican Americans	99-00	105 (93.2-118)	107 (96.6-118)	161 (147-174)	244 (209-302)	368 (279-425)	763
	01-02	78.2 (62.4-98.0)	70.5 (56.2-87.4)	130 (92.9-171)	224 (173-321)	333 (224-656)	664
Non-Hispanic blacks	99-00	115 (80.8-163)	120 (90.4-167)	213 (162-300)	410 (300-549)	652 (482-850)	522
	01-02	102 (85.8-122)	91.8 (79.8-108)	160 (133-202)	296 (234-475)	589 (347-1260)	690
Non-Hispanic whites	99-00	117 (91.4-151)	124 (99.2-150)	203 (173-253)	373 (292-442)	480 (389-671)	821
	01-02	103 (91.5-117)	89.4 (80.2-102)	167 (148-193)	324 (272-368)	447 (365-738)	1204

Figure 18. 3-Hydroxyphenanthrene (creatinine corrected)

Selected percentiles with 95% confidence intervals of urine concentrations (in ng/g of creatinine) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 1999-2002.

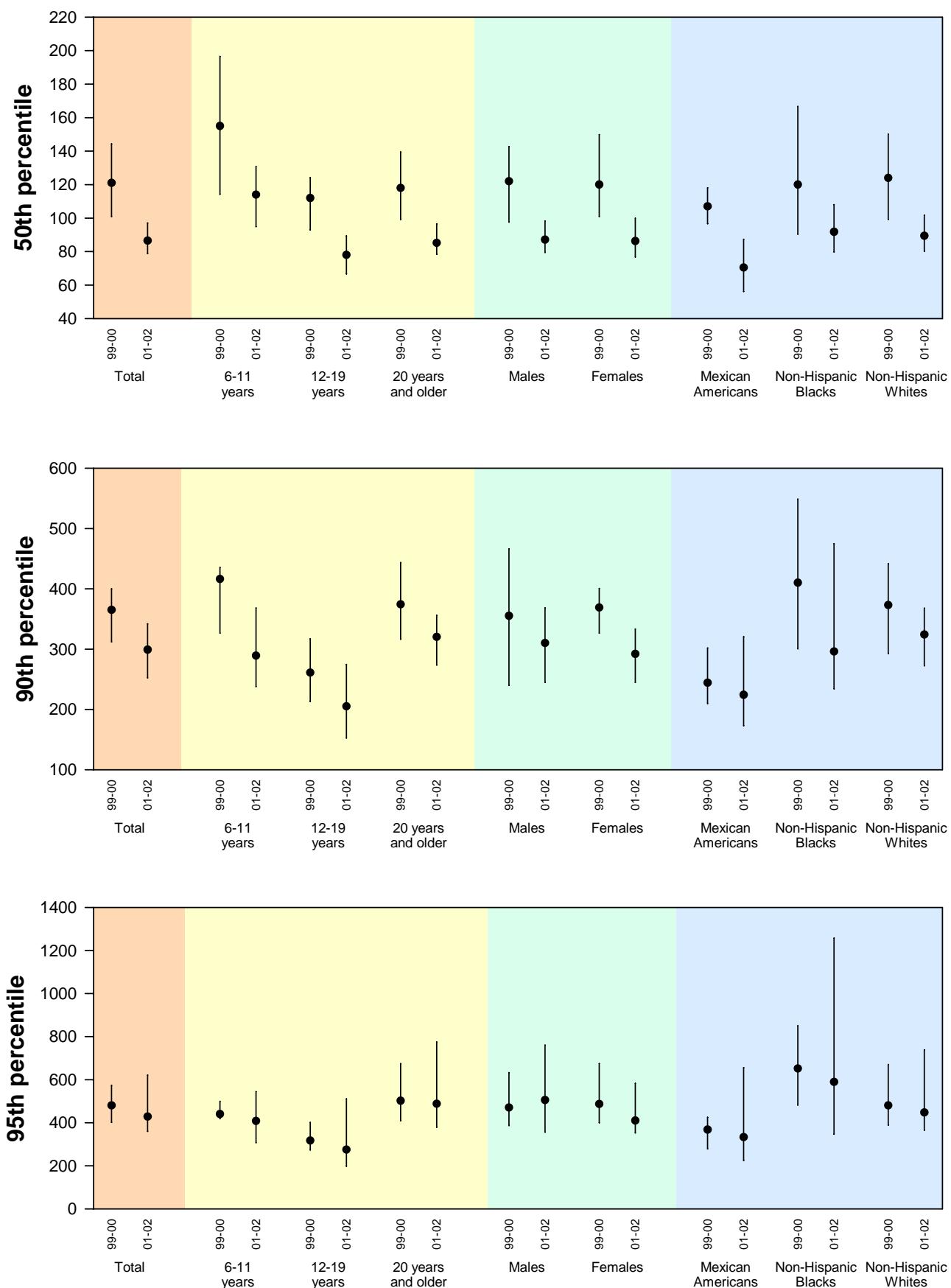


Table 68. 4-Hydroxyphenanthrene

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 2001-2002.

	Survey years	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)				Sample size
			50th	75th	90th	95th	
Total, age 6 and older	01-02	41.9 (31.3-56.0)	67.0 (46.0-92.0)	141 (119-170)	225 (196-254)	280 (250-339)	2741
Age group							
6-11 years	01-02	34.5 (24.3-48.9)	51.0 (30.0-77.0)	118 (87.0-155)	201 (155-256)	250 (184-284)	387
12-19 years	01-02	38.8 (28.9-52.1)	66.0 (38.0-85.0)	131 (112-156)	223 (188-261)	306 (257-358)	733
20 years and older	01-02	43.4 (32.0-58.9)	70.0 (46.0-96.0)	146 (124-173)	228 (196-264)	292 (249-346)	1621
Gender							
Males	01-02	45.3 (33.6-61.0)	73.0 (46.0-99.0)	142 (117-176)	226 (192-250)	287 (247-346)	1344
Females	01-02	38.9 (28.8-52.5)	64.0 (43.0-88.0)	141 (118-165)	222 (190-265)	278 (249-350)	1397
Race/ethnicity							
Mexican Americans	01-02	42.8 (23.7-77.4)	72.0 (25.0-120)	144 (92.0-215)	227 (183-268)	289 (243-398)	664
Non-Hispanic blacks	01-02	48.6 (33.8-69.9)	78.0 (51.0-113)	159 (129-186)	233 (194-276)	277 (240-335)	690
Non-Hispanic whites	01-02	41.1 (29.6-57.0)	66.0 (41.0-96.0)	140 (116-171)	225 (186-266)	287 (247-356)	1204

Table 69. 4-Hydroxyphenanthrene (creatinine corrected)

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 2001-2002.

	Survey years	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)				Sample size
			50th	75th	90th	95th	
Total, age 6 and older	01-02	39.2 (29.6-52.0)	56.5 (39.3-76.3)	121 (97.3-147)	236 (196-273)	347 (293-411)	2741
Age group							
6-11 years	01-02	38.5 (26.4-56.2)	56.7 (25.5-91.0)	123 (92.6-168)	239 (169-278)	314 (243-371)	387
12-19 years	01-02	30.1 (22.5-40.4)	47.8 (29.1-61.4)	89.6 (73.9-112)	165 (132-194)	236 (164-540)	733
20 years and older	01-02	41.0 (30.7-54.9)	58.8 (41.1-79.5)	127 (105-154)	245 (200-292)	371 (300-447)	1621
Gender							
Males	01-02	36.7 (27.6-48.8)	54.5 (34.4-71.6)	109 (88.0-130)	189 (161-224)	282 (252-307)	1344
Females	01-02	41.8 (31.0-56.2)	60.4 (42.4-80.4)	135 (106-170)	268 (227-332)	418 (346-488)	1397
Race/ethnicity							
Mexican Americans	01-02	40.1 (22.8-70.4)	60.7 (26.2-100)	134 (97.5-173)	236 (176-314)	323 (242-408)	664
Non-Hispanic blacks	01-02	34.3 (24.7-47.7)	56.8 (36.8-71.4)	98.8 (84.1-123)	157 (138-176)	230 (193-256)	690
Non-Hispanic whites	01-02	40.6 (29.8-55.4)	58.1 (37.8-81.4)	126 (100-157)	252 (198-297)	387 (293-470)	1204

Table 70. 9-Hydroxyphenanthrene

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 2001-2002.

	Survey years	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)				Sample size
			50th	75th	90th	95th	
Total, age 6 and older	01-02	33.9 (29.7-38.6)	41.0 (36.0-46.0)	87.0 (75.0-103)	205 (169-254)	343 (291-396)	2741
Age group							
6-11 years	01-02	24.7 (21.0-29.1)	32.0 (28.0-39.0)	59.0 (50.0-68.0)	95.0 (70.0-125)	124 (90.0-225)	387
12-19 years	01-02	30.2 (25.1-36.4)	34.0 (31.0-40.0)	70.0 (60.0-86.0)	151 (101-204)	250 (161-312)	733
20 years and older	01-02	35.9 (30.9-41.6)	44.0 (38.0-49.0)	100 (81.0-117)	244 (183-292)	392 (314-476)	1621
Gender							
Males	01-02	39.4 (33.8-46.0)	47.0 (42.0-53.0)	93.0 (76.0-123)	236 (170-290)	381 (269-487)	1344
Females	01-02	29.4 (25.1-34.5)	36.0 (32.0-42.0)	78.0 (69.0-97.0)	179 (151-244)	337 (247-392)	1397
Race/ethnicity							
Mexican Americans	01-02	26.7 (21.2-33.7)	34.0 (26.0-43.0)	62.0 (49.0-78.0)	132 (86.0-202)	202 (124-396)	664
Non-Hispanic blacks	01-02	34.7 (28.5-42.4)	41.0 (36.0-47.0)	104 (81.0-127)	269 (170-391)	399 (285-550)	690
Non-Hispanic whites	01-02	34.6 (30.2-39.7)	43.0 (37.0-48.0)	91.0 (78.0-108)	207 (160-269)	344 (281-421)	1204

Table 71. 9-Hydroxyphenanthrene (creatinine corrected)

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 2001-2002.

	Survey years	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)				Sample size
			50th	75th	90th	95th	
Total, age 6 and older	01-02	31.7 (28.1-35.8)	36.3 (32.3-40.4)	72.1 (63.2-85.9)	156 (139-179)	240 (213-290)	2741
Age group							
6-11 years	01-02	27.6 (23.7-32.2)	35.0 (30.3-40.2)	56.4 (46.3-66.7)	89.5 (72.0-101)	120 (88.9-152)	387
12-19 years	01-02	23.5 (19.9-27.7)	26.7 (22.8-30.6)	44.8 (38.5-55.9)	101 (77.8-118)	158 (107-270)	733
20 years and older	01-02	33.9 (29.7-38.7)	38.8 (34.1-42.9)	80.5 (69.4-102)	175 (148-212)	268 (216-321)	1621
Gender							
Males	01-02	31.9 (27.7-36.8)	36.0 (32.0-40.4)	71.0 (58.6-91.6)	163 (131-187)	218 (182-290)	1344
Females	01-02	31.6 (27.3-36.5)	36.7 (31.7-41.5)	73.1 (63.6-86.6)	151 (133-187)	271 (216-308)	1397
Race/ethnicity							
Mexican Americans	01-02	25.0 (20.7-30.3)	28.2 (24.8-31.8)	52.7 (42.7-68.9)	110 (74.8-160)	166 (107-346)	664
Non-Hispanic blacks	01-02	24.5 (20.0-30.1)	29.4 (25.8-32.7)	63.4 (44.2-84.9)	143 (96.9-209)	233 (153-313)	690
Non-Hispanic whites	01-02	34.3 (30.6-38.4)	39.1 (34.0-43.3)	78.7 (65.2-96.4)	167 (144-199)	268 (216-313)	1204

1-Hydroxypyrene

Metabolite of Pyrene, CAS No. 129-00-0

Interpreting Levels of Urinary 1-Hydroxypyrene Reported in the Tables

Pyrene is commonly found in PAH mixtures, and its urinary metabolite has been used as an indicator of exposure to PAH chemicals. Urinary 1-hydroxypyrene levels were measured in a subsample of NHANES 2001–2002 participants aged 6 years and older. The geometric mean levels of 1-hydroxypyrene in the NHANES 2001–2002 subsample is similar to that of other general populations residing in an urban setting (Goen et al., 1995; Chuang et al., 1999; Heudorf and Angerer, 2001b; Roggi et al., 1997; Yang et al., 2003). Higher levels have been noted for residents of industrialized urban areas compared with rural or suburban settings (Adonis et al., 2003; Kanoh et al., 1993; Kuo et al., 2004).

Many-fold higher levels can be found in workers from certain occupations (Jacob and Seidel, 2002) including aluminum smelting (Alexandrie et al., 2000); diesel engine mechanics (Adonis et al., 2003; Kuusimaki et al., 2004); taxi, bus, and truck drivers (Chuang et al., 2003; Hansen et al., 2004; Kuusimaki et al., 2004); painters (Lee et al., 2003), boilermakers (Mukherjee et al., 2004); toll booth operators (Tsai et al., 2004); traffic police (Merlo et al., 1998) and coke oven plant workers (Lu et al., 2002; Serdar et al., 2003a; Siwinska et al., 2004). Tobacco smoking leads to higher levels in smokers (Chuang et al., 2003; Adonis et al., 2003; Heudorf and Angerer, 2001b) as well as the non-smoking children of smokers (Tsai et al., 2003). Coal stove exposure or consumption of broiled, fried or grilled meat contribute to higher levels of 1-hydroxypyrene (Siwinska et al., 1999; Scheepers et al., 2002; Yang et al., 2003).

Table 72. 1-Hydroxypyrene

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 1999–2002.

	Survey years	Geometric mean (95% conf. interval)		Selected percentiles (95% confidence interval)			Sample size
		50th	75th	90th	95th		
Total, age 6 and older	99-00	79.8 (66.9-95.1)	78.0 (67.9-92.6)	187 (164-229)	434 (372-506)	730 (571-926)	2312
	01-02	49.6 (43.4-56.7)	47.0 (42.0-56.0)	103 (90.0-116)	214 (184-245)	349 (290-400)	2747
Age group							
6-11 years	99-00	90.8 (71.4-115)	94.1 (77.9-120)	170 (136-201)	300 (197-413)	419 (257-757)	310
	01-02	59.7 (52.8-67.5)	59.0 (48.0-66.0)	109 (86.0-150)	212 (164-257)	272 (224-453)	387
12-19 years	99-00	105 (87.8-125)	108 (83.0-130)	226 (188-264)	473 (336-596)	642 (468-1170)	693
	01-02	57.8 (47.4-70.6)	60.0 (44.0-71.0)	111 (89.0-148)	230 (179-273)	329 (267-489)	735
20 years and older	99-00	74.8 (61.5-91.1)	70.1 (61.5-86.1)	187 (155-235)	446 (379-547)	795 (596-940)	1309
	01-02	47.3 (41.1-54.6)	45.0 (40.0-53.0)	100 (88.0-115)	216 (182-246)	361 (290-416)	1625
Gender							
Males	99-00	90.1 (73.2-111)	85.2 (70.5-105)	227 (178-287)	496 (413-577)	747 (577-1020)	1106
	01-02	57.8 (49.8-67.1)	55.0 (46.0-64.0)	120 (97.0-149)	246 (203-312)	416 (299-528)	1348
Females	99-00	71.2 (59.4-85.3)	70.9 (63.1-87.3)	163 (152-188)	361 (300-412)	669 (387-940)	1206
	01-02	43.0 (36.7-50.4)	43.0 (35.0-52.0)	92.0 (76.0-107)	178 (150-199)	278 (219-349)	1399
Race/ethnicity							
Mexican Americans	99-00	74.2 (67.1-82.0)	68.1 (62.7-76.8)	161 (143-179)	344 (284-460)	545 (372-714)	766
	01-02	51.0 (38.0-68.4)	51.0 (40.0-68.0)	99.0 (69.0-133)	163 (125-269)	269 (154-666)	665
Non-Hispanic blacks	99-00	108 (83.9-140)	99.7 (72.2-159)	245 (202-352)	586 (428-778)	839 (496-1480)	528
	01-02	66.2 (56.9-77.0)	63.0 (49.0-82.0)	134 (112-171)	305 (236-386)	442 (337-561)	692
Non-Hispanic whites	99-00	73.7 (58.5-92.9)	72.9 (63.3-86.1)	178 (155-213)	399 (333-506)	747 (477-977)	832
	01-02	46.9 (40.0-55.1)	45.0 (38.0-56.0)	98.0 (87.0-115)	214 (179-249)	343 (271-431)	1207

Comparing Adjusted Geometric Means

Geometric mean levels of urinary 1-hydroxypyrene for the demographic groups were compared after adjusting for the covariates of race/ethnicity, age, gender, log serum cotinine, and urinary creatinine (data not shown). In NHANES 2001-2002, children aged 6-11 years had higher adjusted geometric mean levels of 1-hydroxypyrene than the two other age groups. This age-related difference also has been found by other investigators (Heudorf and Angerer, 2001b; Chuang et al., 1999). In addition, the levels for children in this *Report* are similar to levels measured in other studies (van Wijnen et al., 1996; Chuang et al., 1999; Heudorf and Angerer, 2001a; Kanoh et al., 1993; Tsai et al., 2003). No differences were observed for race/ethnicity or gender, and several previous studies have also not found differences. It is unknown whether these differences associated with age represent differences in exposure, pharmacokinetics, or the relationship of dose per body weight.

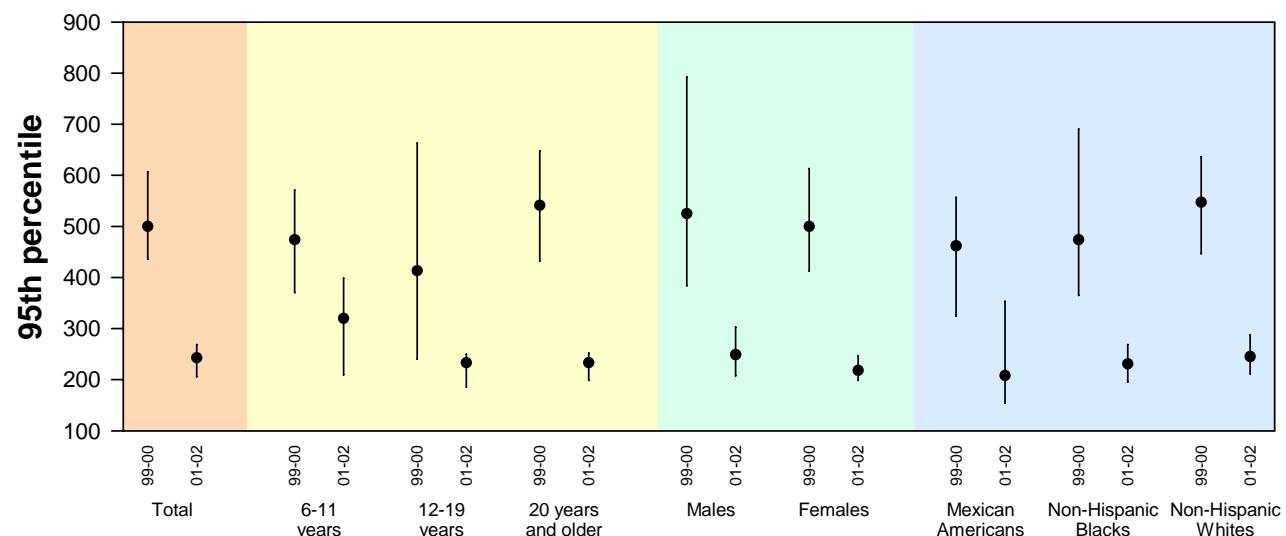
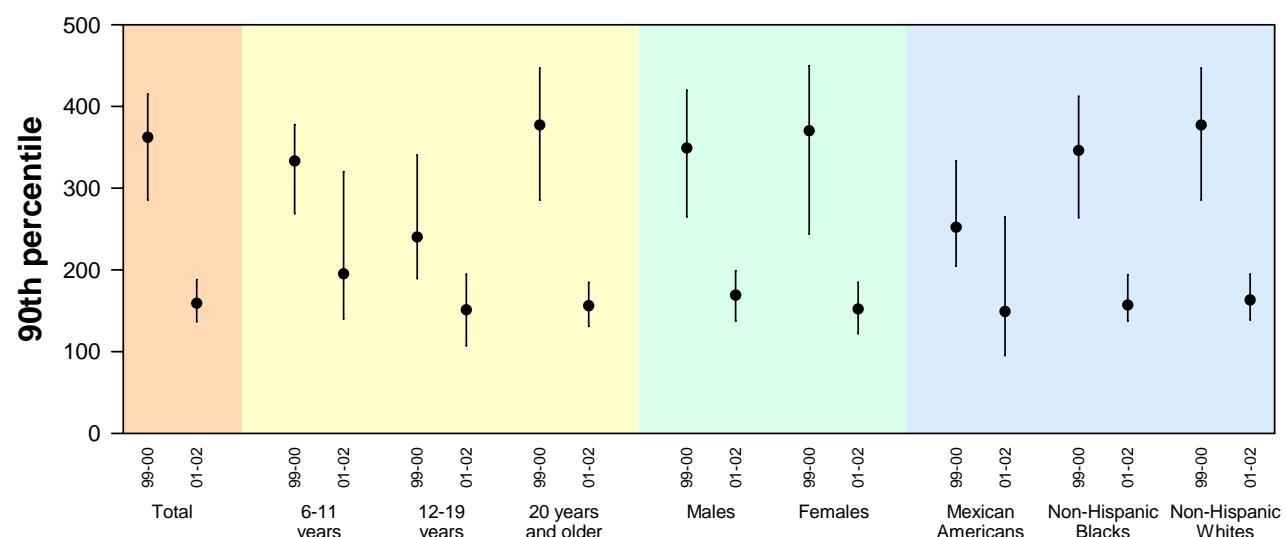
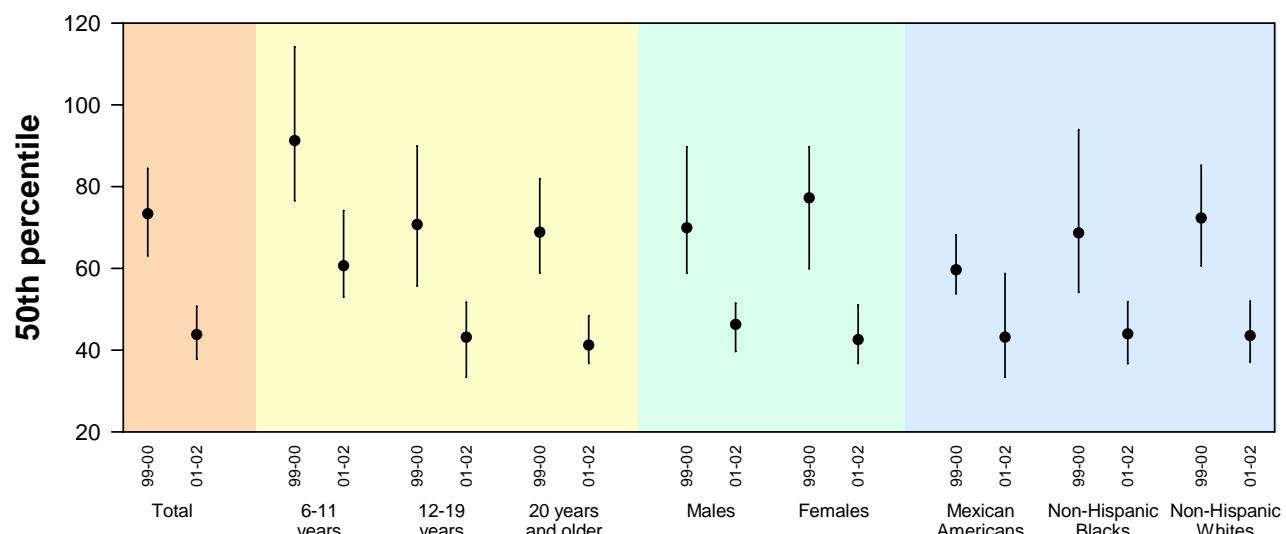
Table 73. 1-Hydroxypyrene (creatinine corrected)

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 1999-2002.

	Survey years	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)				Sample size
			50th	75th	90th	95th	
Total, age 6 and older	99-00	74.2 (61.6-89.3)	73.3 (63.1-84.4)	158 (139-178)	362 (286-415)	500 (436-607)	2312
	01-02	46.4 (40.9-52.8)	43.8 (37.8-50.7)	80.8 (72.9-90.1)	159 (137-188)	243 (206-269)	2747
Age group							
6-11 years	99-00	94.1 (75.3-118)	91.2 (76.5-114)	168 (126-234)	333 (269-378)	474 (371-571)	310
	01-02	66.8 (57.5-77.7)	60.6 (52.9-74.1)	105 (83.3-137)	195 (140-320)	320 (209-399)	387
12-19 years	99-00	71.5 (59.0-86.5)	70.7 (55.6-90.0)	137 (120-170)	240 (189-341)	413 (240-663)	693
	01-02	44.7 (37.8-52.9)	43.1 (33.3-51.7)	71.4 (59.0-87.9)	151 (107-195)	233 (186-250)	735
20 years and older	99-00	72.3 (58.8-88.8)	68.8 (58.9-81.9)	159 (131-188)	377 (286-447)	541 (433-648)	1309
	01-02	44.7 (39.4-50.7)	41.2 (36.7-48.4)	79.5 (72.2-87.5)	156 (131-185)	233 (199-252)	1625
Gender							
Males	99-00	72.1 (56.8-91.6)	69.9 (58.9-89.7)	167 (130-189)	349 (265-420)	525 (384-793)	1106
	01-02	46.8 (40.8-53.7)	46.2 (39.6-51.4)	83.8 (74.1-96.4)	169 (138-199)	249 (207-303)	1348
Females	99-00	76.1 (63.1-91.9)	77.2 (59.9-89.7)	148 (127-183)	370 (244-450)	500 (413-613)	1206
	01-02	46.1 (40.0-53.1)	42.5 (36.7-51.0)	77.3 (68.5-89.5)	152 (122-185)	218 (199-247)	1399
Race/ethnicity							
Mexican Americans	99-00	68.2 (61.8-75.3)	59.6 (53.8-68.1)	124 (110-141)	252 (204-333)	462 (325-557)	766
	01-02	47.6 (36.9-61.5)	43.1 (33.3-58.7)	76.6 (58.7-106)	149 (95.2-265)	208 (155-353)	665
Non-Hispanic blacks	99-00	70.5 (55.6-89.4)	68.6 (54.1-93.9)	156 (121-177)	346 (264-412)	474 (365-691)	528
	01-02	46.6 (40.1-54.2)	43.9 (36.7-51.8)	87.1 (75.0-108)	157 (138-194)	231 (196-269)	692
Non-Hispanic whites	99-00	73.2 (58.1-92.2)	72.3 (60.6-85.2)	163 (133-184)	377 (286-447)	547 (447-636)	832
	01-02	46.4 (40.1-53.6)	43.5 (37.0-51.9)	82.7 (73.7-91.2)	163 (139-195)	245 (211-288)	1207

Figure 19. 1-Hydroxypyrene (creatinine corrected)

Selected percentiles with 95% confidence intervals of urine concentrations (in ng/g of creatinine) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 1999-2002.



3-Hydroxybenzo[a]pyrene

CAS No. 13345-21-6

Metabolite of Benzo[a]pyrene, CAS No. 129-00-0

Interpreting Levels of Urinary 3-Hydroxybenzo[a]pyrene Reported in the Tables

Benzo[a]pyrene is considered a probable carcinogen by the NTP and U.S. EPA. 3-hydroxybenzo[a]pyrene is a metabolite of benzo[a]pyrene and urinary levels were measured in a subsample of NHANES 2001-2002 participants aged 6 years and older. Similar levels of 3-hydroxybenzo[a] pyrene have been reported in a small sample of pre-school children (Wilson et al., 2003) and in workers manufacturing fireproof stone (Gundel et al., 2000).

Table 74. 3-Hydroxybenzo[a]pyrene

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 2001-2002.

	Survey years	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)				Sample size
			50th	75th	90th	95th	
Total, age 6 and older	01-02	*	< LOD	33.0 (28.0-39.0)	95.0 (73.0-121)	179 (137-251)	2748
Age group							
6-11 years	01-02	*	< LOD	26.0 (18.0-41.0)	73.0 (44.0-126)	139 (79.0-273)	387
12-19 years	01-02	*	< LOD	28.0 (20.0-37.0)	77.0 (46.0-129)	139 (82.0-284)	735
20 years and older	01-02	*	< LOD	36.0 (30.0-41.0)	97.0 (72.0-126)	206 (135-285)	1626
Gender							
Males	01-02	*	< LOD	34.0 (29.0-41.0)	98.0 (72.0-126)	167 (133-273)	1349
Females	01-02	*	< LOD	31.0 (26.0-37.0)	86.0 (67.0-117)	206 (134-251)	1399
Race/ethnicity							
Mexican Americans	01-02	*	13.0 (<LOD-16.0)	41.0 (30.0-55.0)	125 (80.0-199)	253 (165-648)	665
Non-Hispanic blacks	01-02	*	11.0 (<LOD-16.0)	29.0 (25.0-37.0)	68.0 (53.0-106)	136 (76.0-240)	692
Non-Hispanic whites	01-02	*	< LOD	32.0 (26.0-40.0)	96.0 (69.0-126)	167 (124-251)	1208

< LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample. See Appendix A for LODs.

* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

Table 75. 3-Hydroxybenzo[a]pyrene (creatinine corrected)

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 2001-2002.

	Survey years	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)				Sample size
			50th	75th	90th	95th	
Total, age 6 and older	01-02	*	< LOD	32.3 (27.3-38.9)	84.7 (69.2-120)	184 (147-248)	2748
Age group							
6-11 years	01-02	*	< LOD	28.8 (22.7-45.5)	91.4 (59.0-171)	207 (91.3-348)	387
12-19 years	01-02	*	< LOD	24.0 (16.7-35.8)	69.8 (43.4-86.7)	103 (77.0-201)	735
20 years and older	01-02	*	< LOD	34.3 (28.4-42.0)	91.7 (69.0-134)	186 (148-263)	1626
Gender							
Males	01-02	*	< LOD	28.9 (23.8-37.8)	72.9 (62.1-99.1)	167 (110-226)	1349
Females	01-02	*	< LOD	35.3 (29.6-43.9)	99.0 (75.0-135)	198 (148-285)	1399
Race/ethnicity							
Mexican Americans	01-02	*	15.3 (12.9-18.3)	41.6 (30.0-58.3)	135 (74.9-188)	225 (157-345)	665
Non-Hispanic blacks	01-02	*	9.86 (8.47-11.1)	21.7 (18.3-26.5)	49.4 (36.2-91.1)	116 (58.6-190)	692
Non-Hispanic whites	01-02	*	< LOD	34.1 (27.3-41.4)	85.7 (68.0-127)	190 (147-263)	1208

< LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample. See Appendix A for LODs.

* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

1-Hydroxynaphthalene and 2-Hydroxynaphthalene

Metabolite of Naphthalene, CAS No. 91-20-3

Interpreting Levels of Urinary 1-Hydroxynaphthalene and 2-Hydroxynaphthalene Reported in the Tables

Urinary levels of 1-hydroxynaphthalene and 2-hydroxynaphthalene were measured in a subsample of NHANES 2001-2002 participants aged 6 years and older. Similar levels have been reported in pre-school children (Wilson et al., 2003), middle school students living in major cities (Kang et al., 2002) and adults (Kim et al., 2003, Kuusimaki et al., 2004, Serdar et al., 2003b). Bus mechanics and truck drivers (Kuusimaki et al., 2004), coke oven workers (Nan et al., 2001; Serdar et al., 2003a), air force personnel exposed to jet fuel (Serdar 2003b), and tobacco smokers (Serdar et al., 2003a; Nan et al., 2001) had higher levels.

Comparing Adjusted Geometric Means

Geometric means levels of urinary 1-hydroxynaphthalene and 2-hydroxynaphthalene for demographic groups were compared after adjusting for the covariates of race/ethnicity, age, gender, log serum cotinine, and urinary creatinine (data not shown). For adjusted geometric mean levels of urinary 1-hydroxynaphthalene in NHANES 2001-2002, non-Hispanic whites had higher

levels than Mexican-Americans, while the group aged 12-19 years had lower levels than either of the groups 6-11 years or 20 years and older.

For adjusted geometric mean levels of urinary 2-hydroxynaphthalene in NHANES 2001-2002, females had higher levels than males, Mexican Americans had higher levels than either non-Hispanic whites or blacks, and the group aged 12-19 years had lower levels than the group aged 20 years and older. It is unknown whether these differences associated with age, gender or race/ethnicity represent differences in exposure, pharmacokinetics, or the relationship of dose per body weight.

Note: 1-hydroxynaphthalene is sometimes called 1-naphthol and 2-hydroxynaphthalene is also referred to as 2-naphthol.

Table 76. 1-Hydroxynaphthalene

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 2001-2002.

	Survey years	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)				Sample size
			50th	75th	90th	95th	
Total, age 6 and older	01-02	2050 (1790-2340)	1720 (1490-2030)	4760 (3890-5930)	12500 (10600-15900)	22300 (18000-26600)	2748
Age group							
6-11 years	01-02	1430 (1170-1730)	1190 (1010-1560)	2740 (1770-3630)	6670 (4340-11300)	12400 (9410-16500)	387
12-19 years	01-02	1750 (1440-2130)	1380 (1210-1690)	3560 (2840-4570)	9270 (6760-17200)	21400 (10400-28500)	735
20 years and older	01-02	2190 (1900-2530)	1890 (1580-2280)	5280 (4250-6520)	13600 (11100-18000)	23300 (18100-28600)	1626
Gender							
Males	01-02	2270 (1940-2650)	1980 (1640-2440)	5580 (4000-6950)	12200 (9650-16700)	21500 (15100-28500)	1349
Females	01-02	1860 (1600-2160)	1560 (1320-1760)	4120 (3380-5030)	13300 (11100-16300)	22300 (19400-25500)	1399
Race/ethnicity							
Mexican Americans	01-02	1590 (1300-1960)	1440 (1180-1860)	3010 (2240-4080)	6750 (4990-9270)	11900 (7670-20600)	665
Non-Hispanic blacks	01-02	2700 (2160-3370)	2190 (1630-2930)	7170 (4400-10900)	14900 (11900-22100)	24700 (17000-44100)	692
Non-Hispanic whites	01-02	2030 (1720-2390)	1740 (1470-2150)	4680 (3630-5990)	12300 (10200-16300)	22300 (16600-27200)	1207

Table 77. 1-Hydroxynaphthalene (creatinine corrected)

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 2001-2002.

	Survey years	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)				Sample size
			50th	75th	90th	95th	
Total, age 6 and older	01-02	1910 (1700-2160)	1560 (1370-1810)	4160 (3550-5170)	10500 (8470-12600)	17800 (14500-20800)	2748
Age group							
6-11 years	01-02	1600 (1320-1930)	1370 (1040-1780)	2880 (2140-3840)	5280 (4450-9720)	12900 (7960-26400)	387
12-19 years	01-02	1350 (1140-1600)	1130 (973-1360)	2520 (2090-3160)	6920 (3790-11000)	11200 (8240-16100)	735
20 years and older	01-02	2070 (1830-2350)	1720 (1480-2000)	4980 (3930-6120)	11600 (9370-14200)	18600 (15000-22000)	1626
Gender							
Males	01-02	1830 (1580-2120)	1550 (1300-1880)	4050 (3380-5360)	9440 (7550-11400)	14200 (12200-16500)	1349
Females	01-02	1990 (1760-2250)	1620 (1360-1900)	4190 (3560-5190)	12400 (9810-15000)	20500 (17100-26700)	1399
Race/ethnicity							
Mexican Americans	01-02	1490 (1240-1780)	1310 (1070-1630)	2590 (2140-3370)	5710 (4280-7530)	10300 (6120-18300)	665
Non-Hispanic blacks	01-02	1900 (1500-2410)	1640 (1340-1980)	4400 (2830-6450)	10100 (6560-15900)	18900 (11700-32700)	692
Non-Hispanic whites	01-02	2000 (1740-2300)	1660 (1410-1940)	4410 (3660-5790)	10900 (8640-13400)	17300 (13400-19600)	1207

Table 78. 2-Hydroxynaphthalene

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 2001-2002.

	Survey years	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)				Sample size
			50th	75th	90th	95th	
Total, age 6 and older	01-02	2470 (2110-2890)	2280 (1920-2640)	5680 (4580-6830)	14700 (12800-19500)	26000 (22500-29700)	2748
Age group							
6-11 years	01-02	1690 (1560-1840)	1700 (1400-1950)	3000 (2580-3470)	5350 (3890-6700)	7720 (6300-9540)	387
12-19 years	01-02	2220 (1700-2900)	2150 (1740-2530)	4390 (3150-6110)	11000 (6990-20400)	22500 (13900-28400)	735
20 years and older	01-02	2620 (2220-3100)	2440 (1940-2950)	6380 (5110-8110)	17600 (14000-21100)	28100 (23300-33700)	1626
Gender							
Males	01-02	2750 (2360-3210)	2510 (2090-2970)	6040 (4820-7810)	16400 (11900-23000)	28100 (20800-35600)	1349
Females	01-02	2220 (1860-2660)	2060 (1650-2480)	5240 (3890-6440)	13900 (12300-17700)	25100 (19700-28300)	1399
Race/ethnicity							
Mexican Americans	01-02	2700 (2360-3080)	2690 (2350-3260)	5140 (4360-6150)	9600 (8150-10600)	13600 (10400-18700)	665
Non-Hispanic blacks	01-02	3970 (3470-4540)	3460 (3100-4020)	9250 (6820-13200)	22800 (16000-29100)	33000 (25900-38700)	692
Non-Hispanic whites	01-02	2190 (1760-2720)	1910 (1610-2420)	4880 (3710-6780)	14100 (10700-20200)	25900 (20700-30000)	1207

Table 79. 2-Hydroxynaphthalene (creatinine corrected)

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 2001-2002.

	Survey years	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)				Sample size
			50th	75th	90th	95th	
Total, age 6 and older	01-02	2310 (1980-2680)	1940 (1670-2300)	4730 (3820-5860)	11500 (9980-13100)	16700 (14100-19200)	2748
Age group							
6-11 years	01-02	1890 (1740-2070)	1830 (1720-1940)	3110 (2510-3470)	5040 (4380-5540)	6490 (5270-12400)	387
12-19 years	01-02	1720 (1350-2190)	1510 (1340-1830)	2750 (2080-4070)	7060 (4070-10900)	10900 (7860-17400)	735
20 years and older	01-02	2480 (2130-2880)	2080 (1680-2600)	5630 (4460-6940)	12400 (10900-13900)	17700 (15200-20600)	1626
Gender							
Males	01-02	2230 (1900-2610)	1850 (1630-2100)	4750 (3510-6120)	11400 (8950-14300)	15800 (13100-19200)	1349
Females	01-02	2380 (2050-2770)	1970 (1660-2560)	4730 (3790-6000)	11500 (10300-12800)	17400 (13700-21500)	1399
Race/ethnicity							
Mexican Americans	01-02	2520 (2230-2850)	2350 (2010-2950)	4650 (3970-5210)	7120 (6050-8090)	12000 (7820-15300)	665
Non-Hispanic blacks	01-02	2790 (2390-3270)	2390 (2040-2770)	5980 (4840-6980)	11600 (9090-15300)	17400 (12200-23400)	692
Non-Hispanic whites	01-02	2160 (1780-2620)	1740 (1440-2180)	4340 (3320-6090)	11900 (9930-14300)	16900 (13800-20600)	1207

Results by Chemical Group

Polychlorinated Dibenzo-p-dioxins, Polychlorinated Dibenzofurans, and Coplanar and Mono-ortho-substituted Polychlorinated Biphenyls

